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ELECTRONIC COMPUTER PROGRAMMING INSTITUTE

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I·B·M Data Processing and Computer Programming Course

STUDY UNIT I

LESSON 1 - 2 - 3 - 4

I.B.M. DATA PROCESSING AND COMPUTER PROGRAMMING

LESSON ONE

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PREFACE

Nowhere are the prospects for employment and advancement brighter than they are in the field of I.B.M. Data Processing and Computer Programming. Thousands of companies throughout the United States, and for that matter in many foreign countries, are using I.B.M. machines in the most modern offices for processing countless numbers of office functions. You can prepare for the many high-paying positions available in the fields of PROGRAMMING, CONSOLE MACHINE OPERATION, TABULATING MACHINE OPERATION and other professional types of career positions.

We here at Electronic Computer Programming Institute Inc., are eager to help you. We have assembled for your education and training a complete, easy-to-understand, well-illustrated series of lessons. Our Resident Training program places at your disposal I.B.M. equipment worth hundreds of thousands of dollars. This is made available to you — to enable you to join the many who have made professions in the field of I.B.M. Data Processing.

Proceed at your own pace — use your spare time to prepare yourself for the type of employment that means higher earnings, job security and professional status. Our staff at Electronic Computer Programming Institute Inc. is at your service to assist you in gaining success in the wonderful field of I.B.M. Data Processing and Computer Programming.

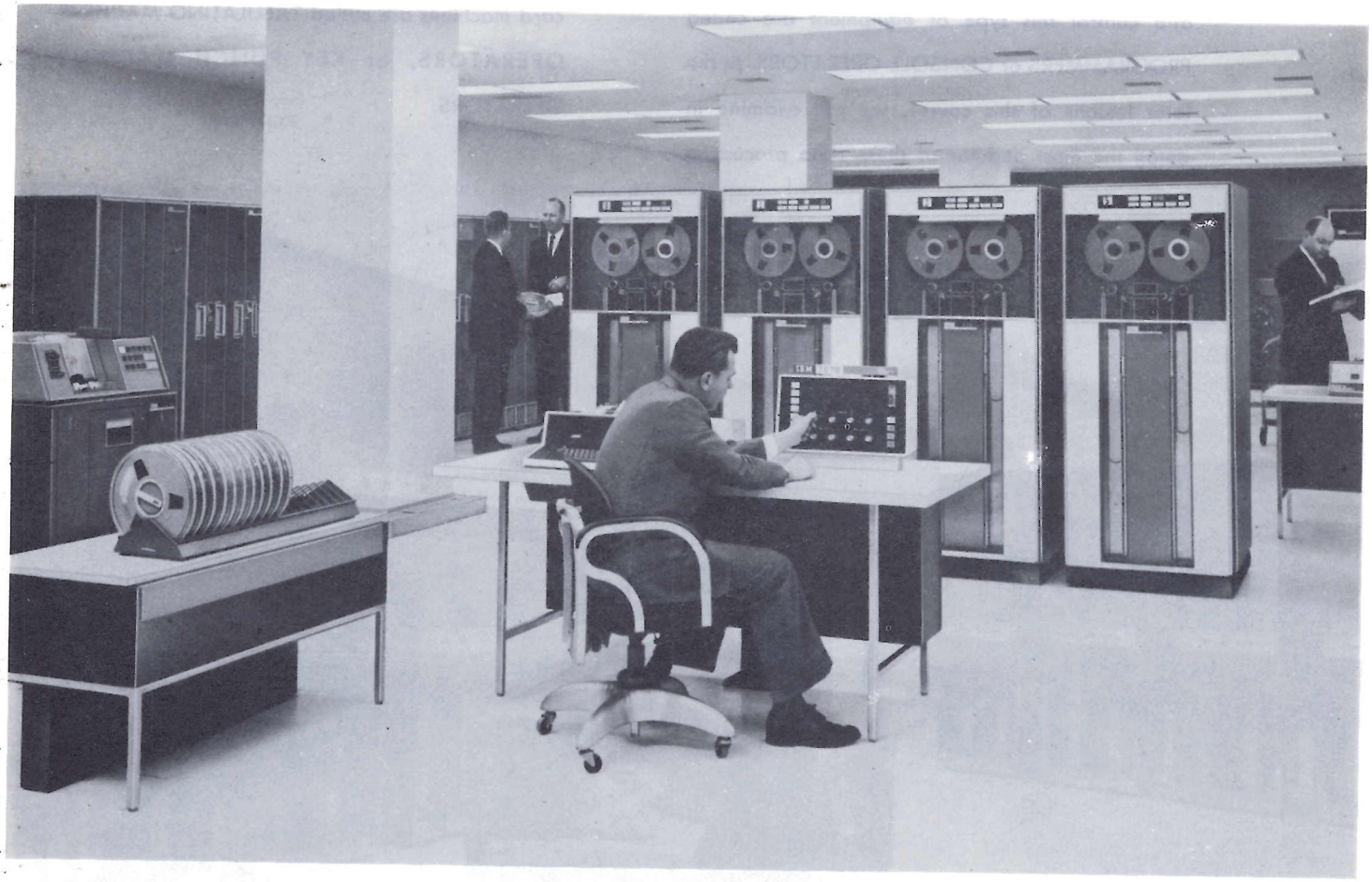
*We wish to thank International Business Machine Corp., Minneapolis-Honeywell Corp., and Remington Rand for their cooperation in furnishing the photographs used in this lesson.

1.1 Introduction to I.B.M. Data Processing

The purpose of this course is to prepare you for the many career positions available to men and women in the field of I.B.M. Data Processing. In this first lesson we will generally survey and acquaint you with the various data processing systems and types of equipment which are currently available. The types of equipment discussed will fall generally into two groups:

1. Electronic Data Processing Systems: these are the latest developed concepts in the field of automated office equipment. Men and women who use and control this type of equipment are called PROGRAMMERS or CONSOLE OPERATORS. In the later lessons of this course, we will examine in detail the most popular of these data processing systems, the I.B.M. 1401 Electronic Data Processing System.

2. Punched Card Data Processing Systems and Equipment: these machines are used by thousands of companies to enable them to run their office functions most efficiently. There are various machines which form the Punched Card Data Processing System and in future lessons we will examine and study many of them in detail. The men and women who are employed in industry using punched card machines are called TABULATING MACHINE OPERATORS, or KEY PUNCH MACHINE OPERATORS.

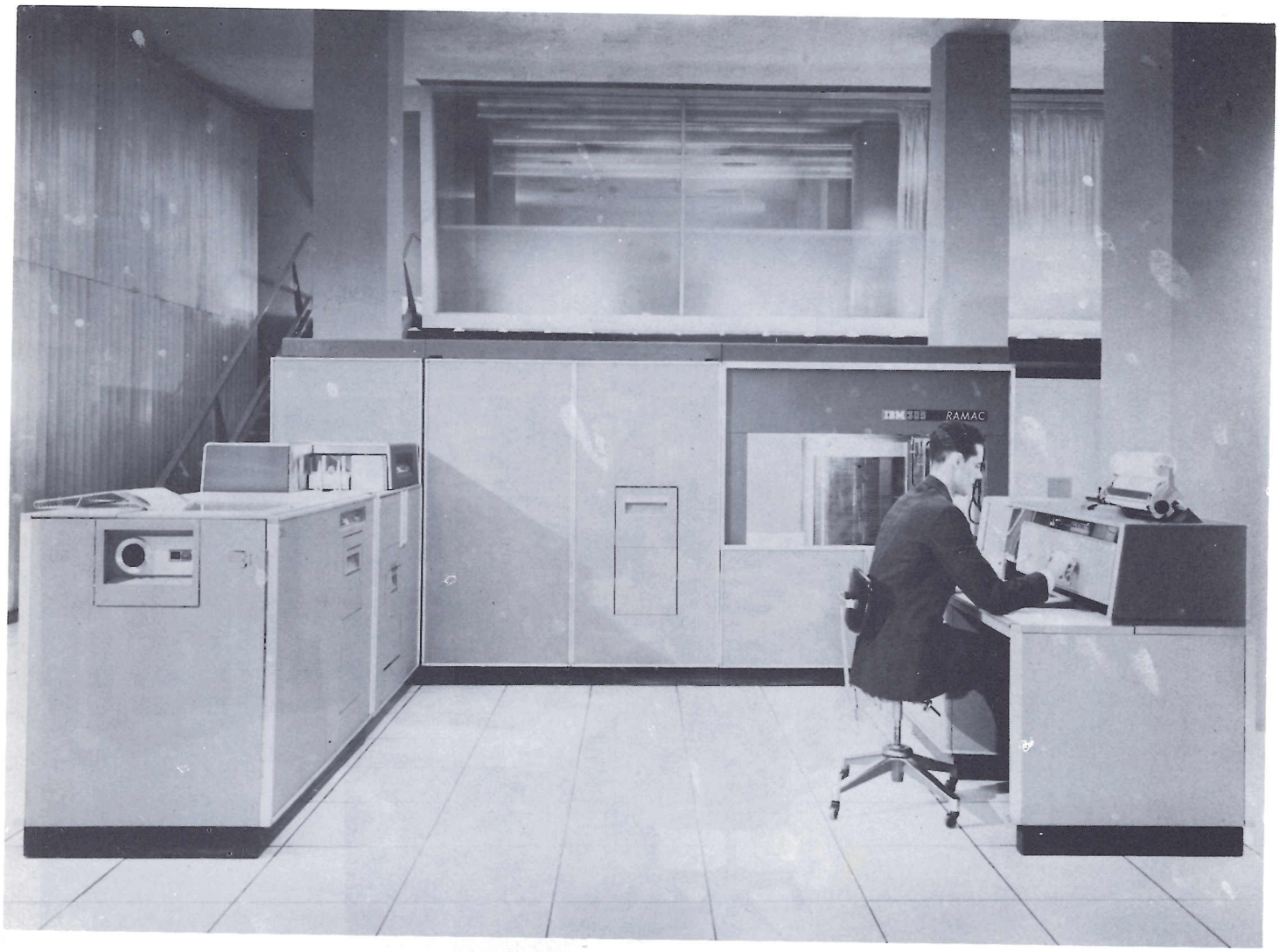


1.2 Introduction to Office Automation

ELECTRONIC DATA PROCESSING

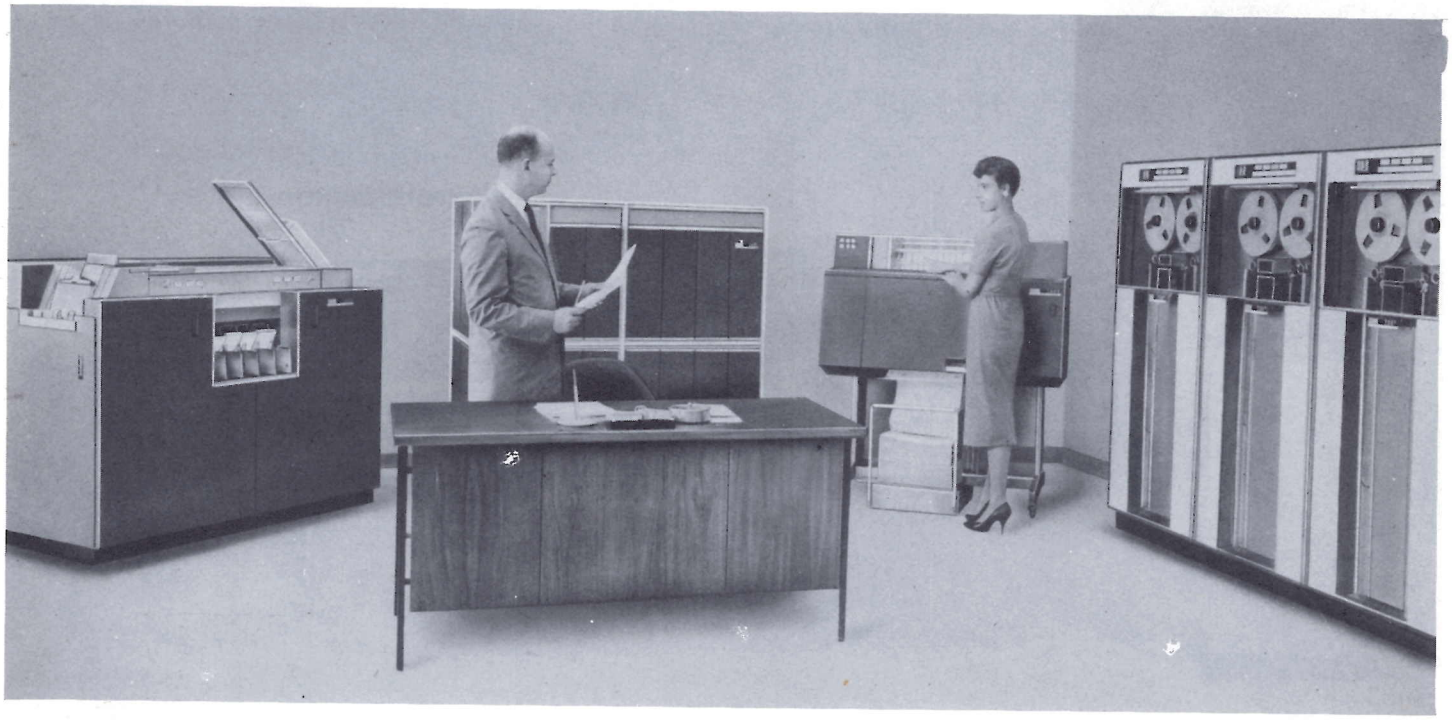
The rapid rise in clerical employment reflects the ever-increasing volume and complexity of the clerical work handled by the nation's expanding industries and government agencies. In this work, clerical employees have for many years used typewriters and a variety of other machines, including adding, calculating, bookkeeping, billing and duplicating machines. More recently, thousands of offices have installed punched card equipment which records data in cards, and which then sort the cards to tabulate and print the data from them. Despite these advances, the number of office workers has continued to climb and employers are constantly looking for new and improved machines to handle the ever-growing workload.

In the last few years, attention has been focused on a new development in office machines — the use of electronic computers to handle tremendous amounts of data. Electronic computers have attracted great interest because of their ability to perform millions of computations — adding, subtracting, dividing and multiplying — automatically and at speeds measured in millionths of a second. At one government installation, it was estimated that it would take one person a year to perform computations on a desk calculator that could be done in about half an hour by an electronic computer!



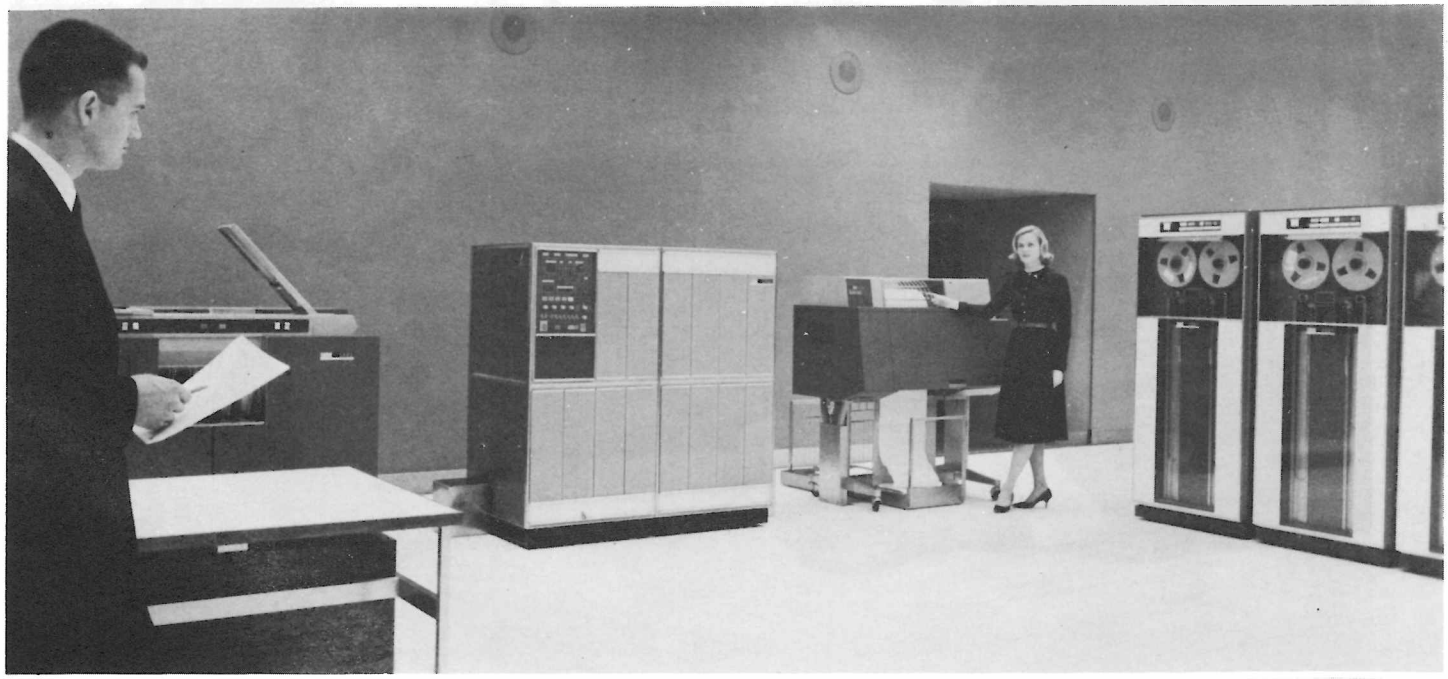
When a computer is assembled in a unit with various types of related equipment, an electronic data processing system is formed. Such a system consists of a central computer and assorted other pieces of equipment including convertors which transfer information from punched cards to magnetic tape (or the reverse operation); readers that make the information of the tape or cards usable by the computer; and printers that record the final results in a form that can be read.

Although computers are often described as machines that can "think", this is, of course, not true. Like other machines they must be operated or controlled by men and women who start them, feed work into them, make certain that they operate properly, remove the completed work or otherwise supervise them. Computers are useless unless they are given the proper instructions for performing the work necessary for the final result. The men and women who are responsible for the proper use of these wonderful machines are called PROGRAMMERS AND CONSOLE OPERATORS.



1.3 Application of Electronic Data Processing Systems:

Computers can be used to perform many of the accounting and related functions commonly required in the office. Electric, gas and telephone companies, for example, are using computers to make up the monthly bills for many thousands of customers; the computing systems does the complete job of printing the customer's name and address on a bill, listing each item, figuring the cost, adding taxes and other necessary items, and then adding the entire bill. Payroll work, including computation of the amounts to be paid and printing of checks for thousands of employees is a common computer application. In large insurance companies, the machines may be used to prepare notices of premiums due, computer dividends, calculate agents' commissions and make the millions of computations used in the actuarial and statistical departments.

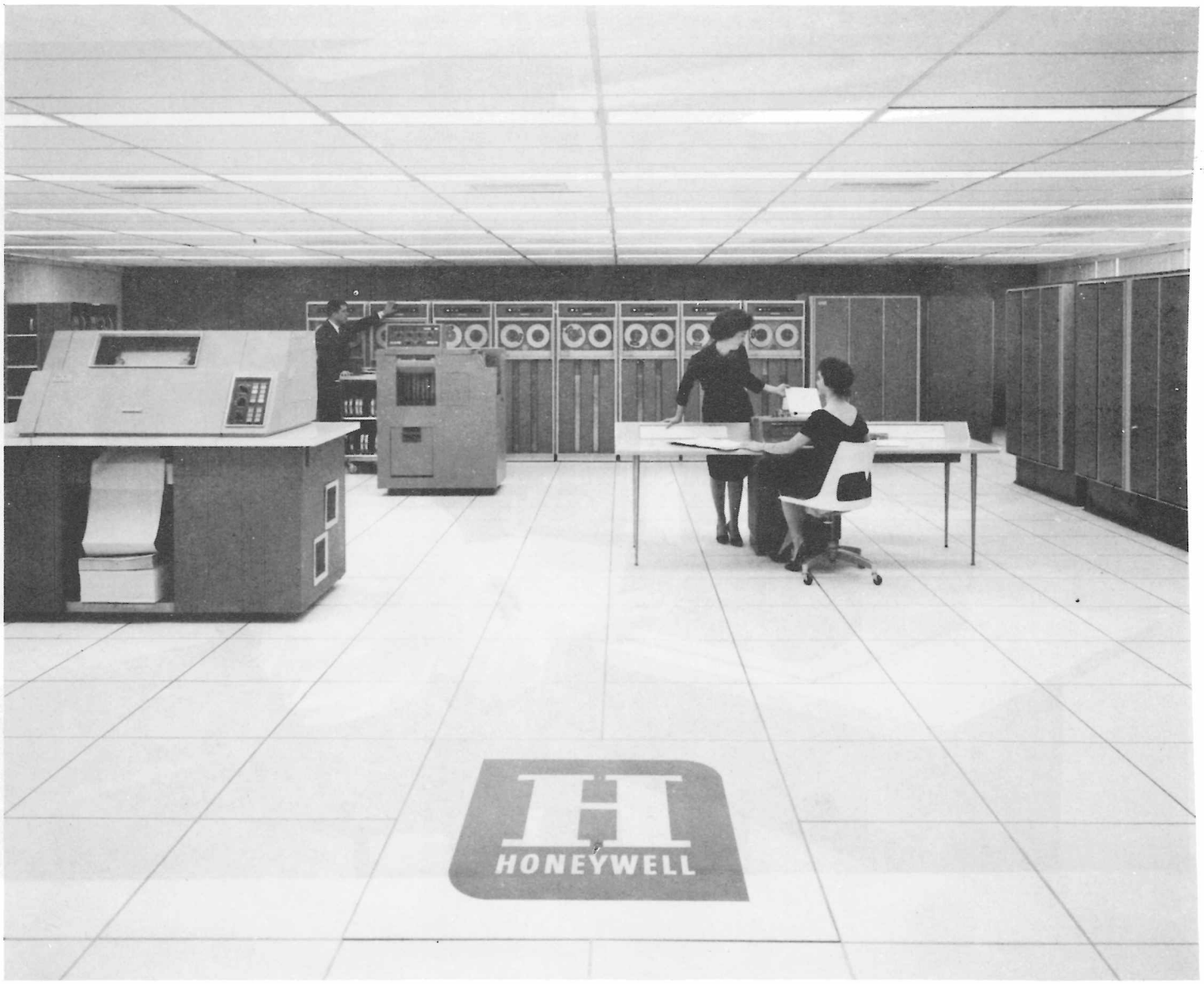


All types of business firms use computers in inventory control, accounts receivable and many other accounting functions. Computers are also used to help companies plan for the future — to analyze the market for goods, forecasting sales and estimating production requirements.

In firms doing a nation-wide business, a computer can be linked with telephone or telegraph equipment so that a sales order can be prepared in the company branch office and transmitted to the main office for processing and shipment. The information produced in this operation can then be processed by the computer to prepare up-to-the-minute sales or inventory reports at the same time that the order is being filled and shipped at the company's warehouses.

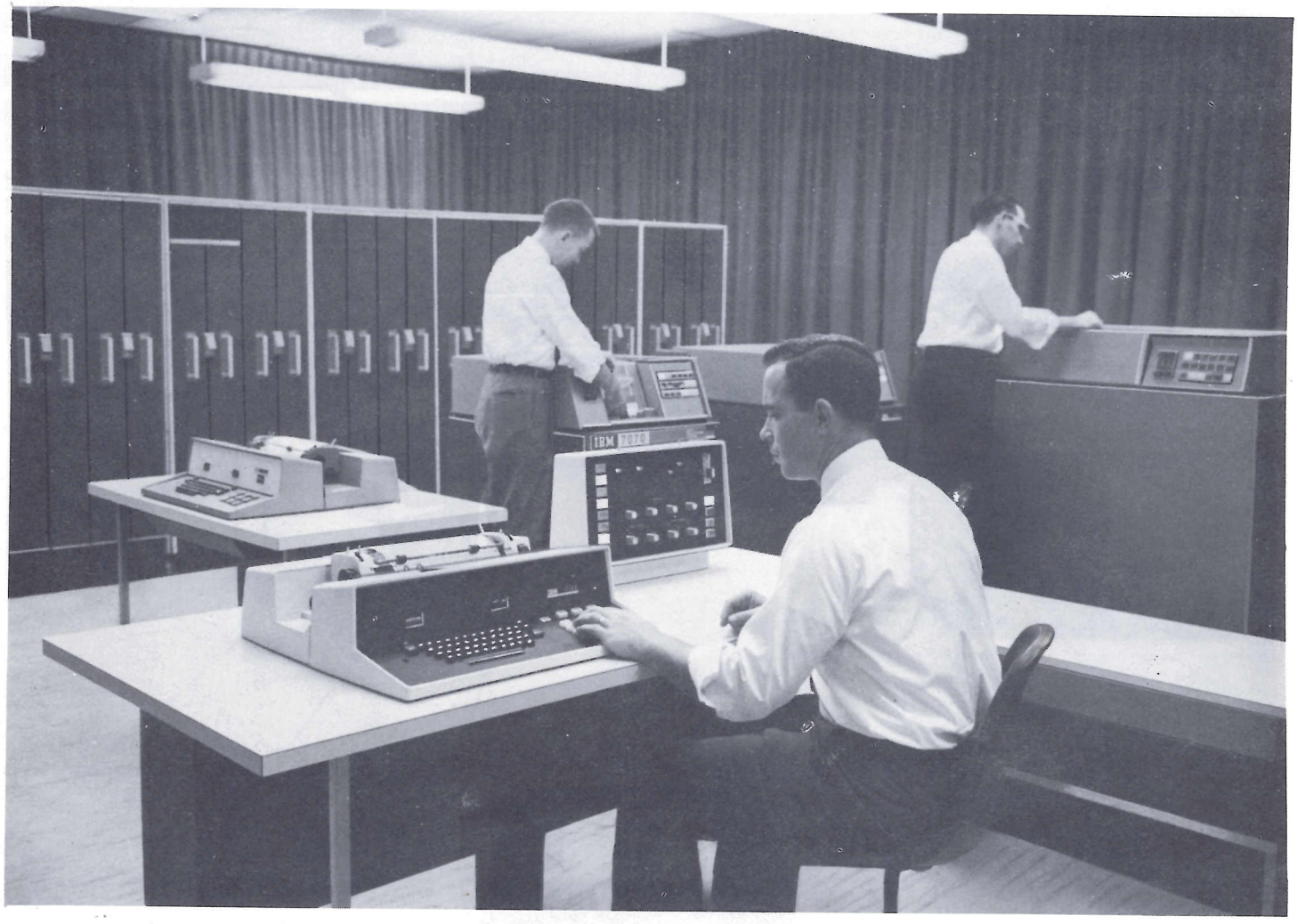
In government offices, computers are used in large-scale statistical operations and in the preparation of government reports. The tremendous clerical efforts involved in keeping records for the millions of workers covered by social security and of digesting the mass of data collected by the Census Bureau are areas where computers are especially helpful. An Electronic Data Processing system in one state keeps up-to-date records for nearly 5 million automobile drivers by name, address, date of birth, sex, and driving records — and even determines fines for traffic violations.

The uses of computers in government and industry is limitless. The continued use of ingenuity by the men and women who use this equipment opens up new horizons and new opportunities.



1.4 The Programmer and Console Operator

The occupations of PROGRAMMER and CONSOLE OPERATORS are two of the newest in the country. The PROGRAMMER uses his knowledge of the machine to plan the most efficient way to use the computer. He will write instructions showing the logical order in which the various operations are to be performed by the computer. The CONSOLE OPERATOR is responsible for the operation of the equipment and the most efficient scheduling of the machine to achieve maximum use of the data processing system.



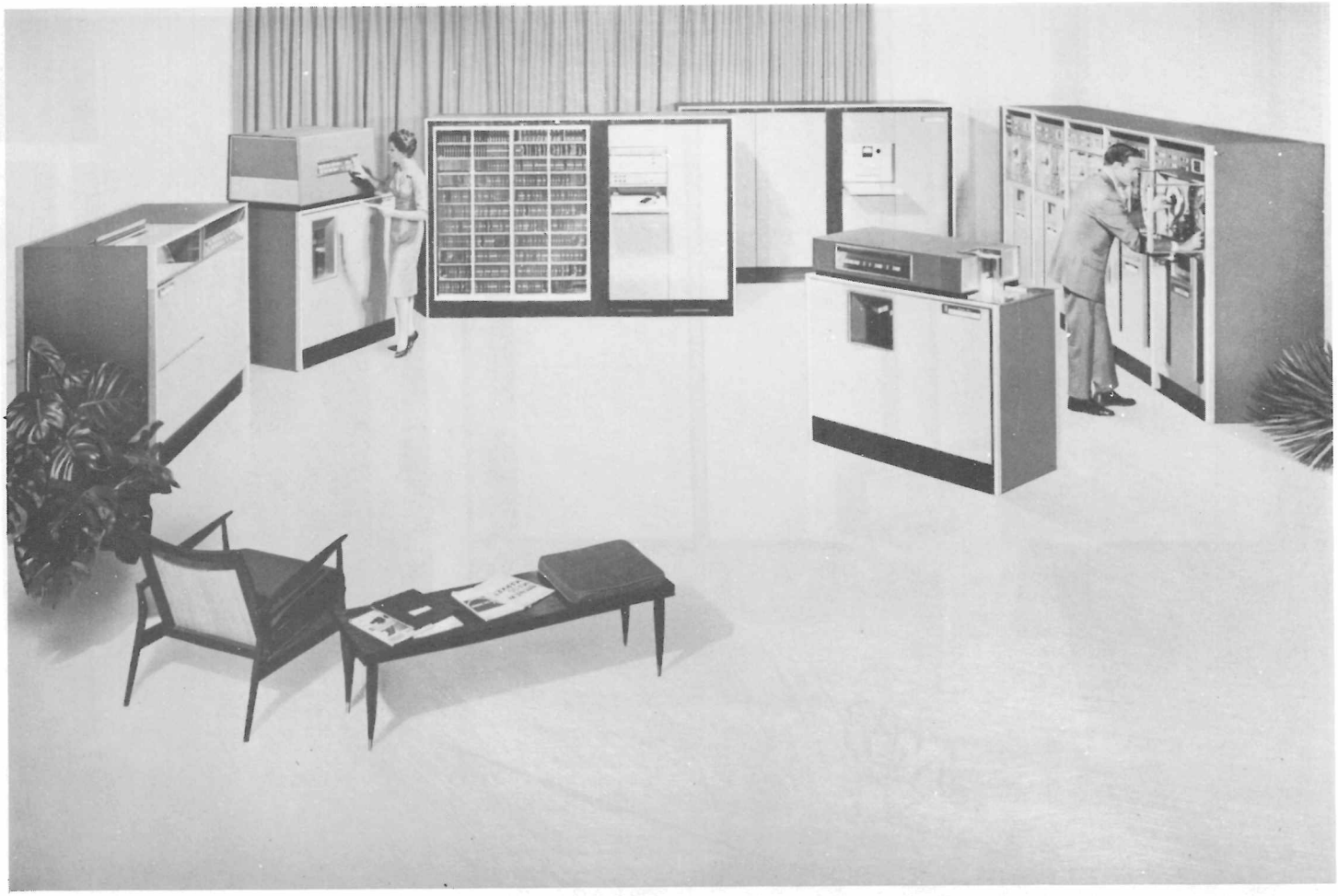
1.5 Introduction to I.B.M. Punched Card Data Processing

IBM Punched Card Data Processing has been in use for almost three quarters of a century. The punched card was first utilized to enable the United States Census Bureau to process the mass of facts which it collected at census time. Each card was used to record the facts about a specific family — these cards were then processed by IBM machines to provide census figures.

Commercial use of IBM equipment started in the early 1900's. The record-keeping and accounting functions of many businesses became too complex to be handled by manual means. The solution to many company's problems was to use IBM Punched Card Data Processing machines to reduce the mountains of paperwork, reduce the cost of record-keeping and provide up-to-the minute accurate reports for the management of the company.

IBM Punched Card Data Processing makes use of a variety of different machines, each one of which performs specific functions. The basic IBM machine is the Card Punch which is used to create the original IBM card; from this point, the cards would be processed by the IBM Interpreter which prints on the face of the card the numbers and letters which are punched in the card. An IBM Sorter is used to place cards in sequence. The IBM Collator and Reproducer are machines which are used to interfile cards or automatically re-create new cards. Accounting machines (tabulators) are used to extract important information from cards and prepare reports and other meaningful documents for the company.

All these machines when grouped together form an IBM Data Processing System. It is the responsibility of the Tabulating Machine Operator to use this equipment efficiently. Part of his responsibility is in the area of preparing these machines for use; setting them up for a particular job. This is accomplished by placing in the machine a control panel which has been accurately prepared. This function in IBM Punched Card Data Processing, called "Control Panel Wiring", will be discussed in detail in the lessons that follow.



The use of the punched card has spread to almost every area of commerce and government. The punched card because of its flexibility and simplicity of use has met with wide-spread acceptance.

In the lessons that follow, we will study in detail the two areas of I.B.M. Punched Card Data Processing and I.B.M. Electronic Data Processing. For every lesson after this one there will be an examination which you are required to complete and return to us for grading and comments.

Good luck! You are on your way to a new career.

I.B.M. DATA PROCESSING AND COMPUTER PROGRAMMING

LESSON TWO

TABLE OF CONTENTS

2.1) I.B.M. Punched Card Data Processing

2.2) The IBM Card

Reading the card; numeric and alphabetic information; special punches.

2.3) IBM Card Fields

2.4) Distinguishing between Types of Cards

Glossary

Examination

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2.1 I.B.M. Punched Card Data Processing

The primary reason for the popular use of I.B.M. Punched Card Data Processing by industry has been the speed, flexibility and accuracy which can be attained by using punched card systems properly.

The basic principle in I.B.M. Punched Card Data Processing is that once information has been placed in an IBM card it can then be used over and over again and processed at high rates of speed by other machines which have been specifically designed to handle IBM cards. All data in order to be used in the IBM system must first be placed into cards. We shall therefore examine in detail, the IBM card and then will study the means used to place information into the cards.

2.2. The I.B.M. Card

The standard IBM card measures 7⅞ inches by 3¼ inches and is .007 inches in thickness. The card stock is of a special quality to insure long life and multiple usage. A sample card is enclosed as part of this lesson. Let us now examine the card illustrated below.

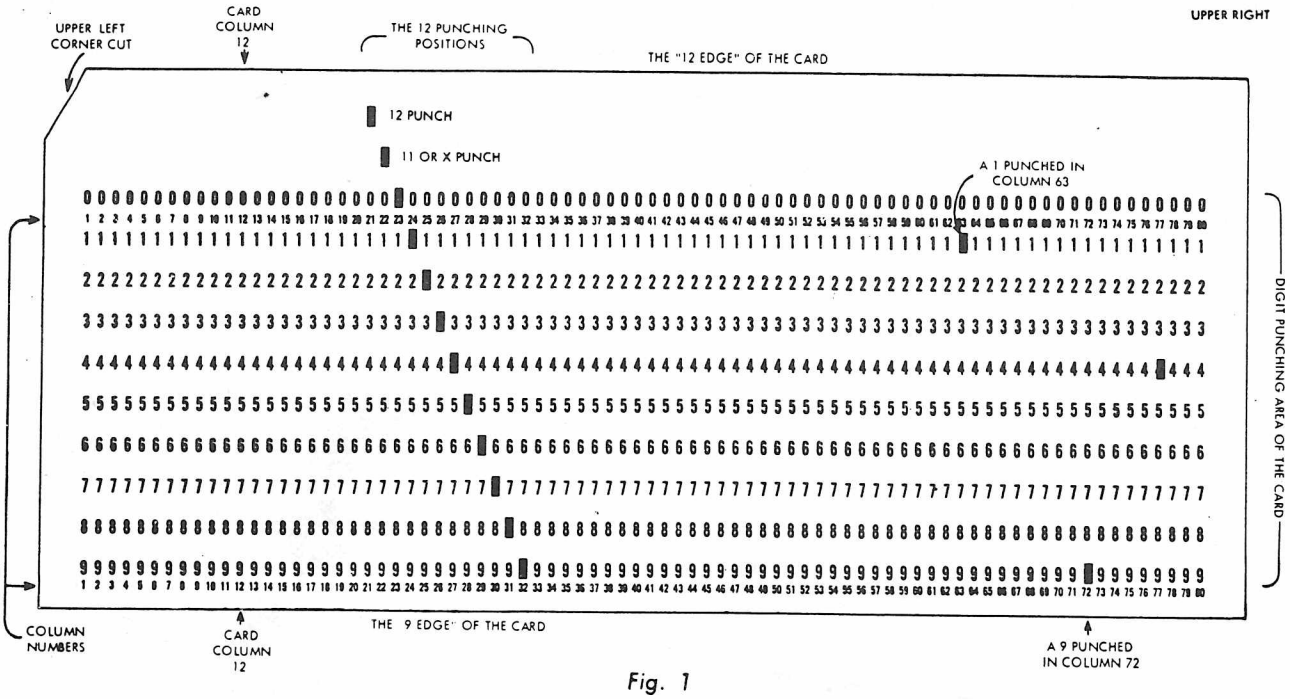
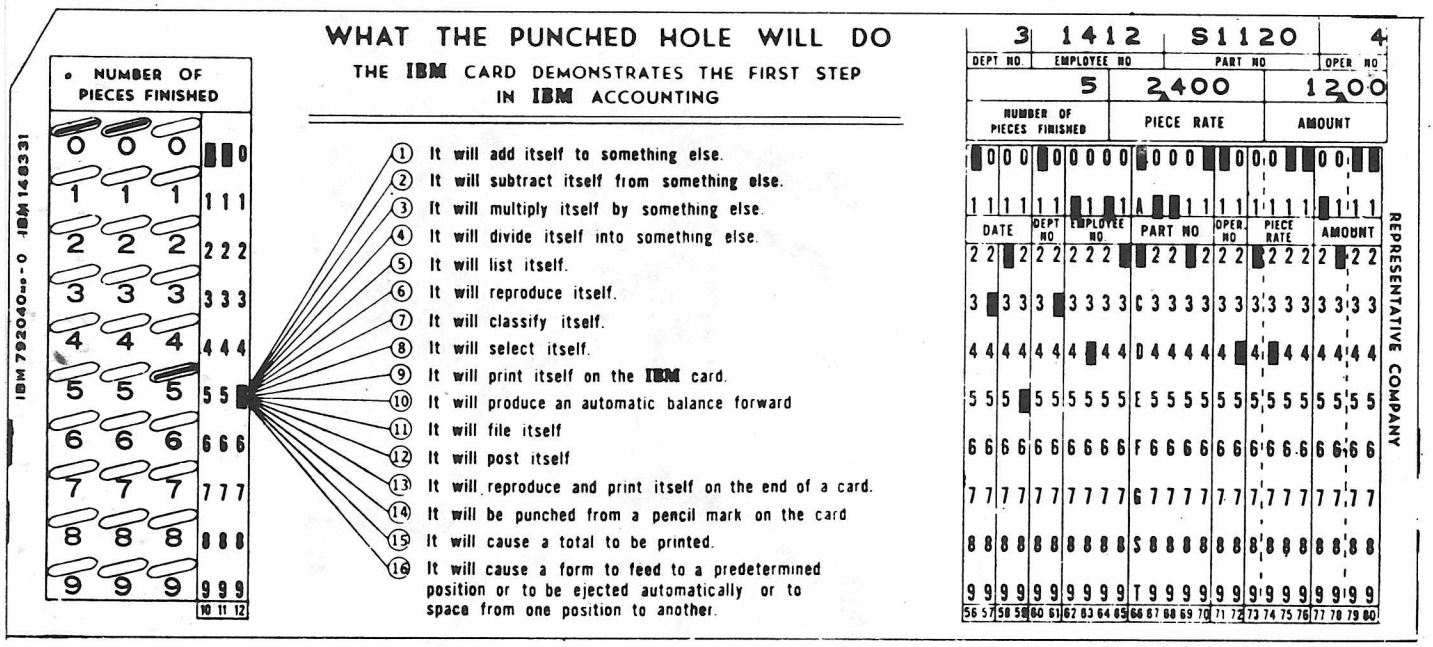


Fig. 1



Looking at this card from left to right you will notice that it is divided into 80 vertical areas which are referred to as "columns" or "card columns." Each card column can contain a single character of information.

Characters are divided into three groups:

Digits — the numbers 0-9

Alphabetic letters — A-Z

Special characters — these are special symbols and punctuations such as the characters &#,$.-/@%*

Any column in the card may contain any valid IBM character.

Each column in the card is assigned a number. The column at the extreme left of the card is called column 1; the column at the extreme right of the card is called column 80. As you can see each column on the card is assigned a number. These numbers appear on the bottom edge of the card and also towards the top of the card between the lines numbered 0 and 1.

The card at the time it is manufactured is a perfect rectangle. For the purposes of identification, it is common practice to cut one or more of the corners; in this illustration, the upper left hand corner has been cut.

Looking at the card from left to right then, we see that it is divided into 80 columns each one of which is numbered and each one of which contain a single character of information (either a digit, an alphabetic letter, or a special character.)

The IBM card can also be sub-divided from top to bottom. In this instance we have 12 areas called punching zones. The topmost punching position is called the "12 zone" or "12 punch"; directly underneath the 12 zone is the "11 zone" or "11 punch"; directly underneath the 11 zone are the 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 zones.

The zones 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 are called the numeric zones; the zones 11 and 12 are called the alphabetic zone; the 0 zone can also be an alphabetic zone. Therefore the 0 zone can at times be a numeric zone, and at times be an alphabetic zone, depending on how it is used. We will discuss this very soon.

The top edge of the card is called the "12 edge"; the bottom edge of the card is called the "9 edge". This is important because in some IBM machines you will learn that cards are fed in 12 edge first; in other IBM machines, the cards are fed in 9 edge first.

HOW IS DATA PUNCHED IN AN IBM CARD

Let us examine figure 2 below to see how data or information is recorded in the IBM card:

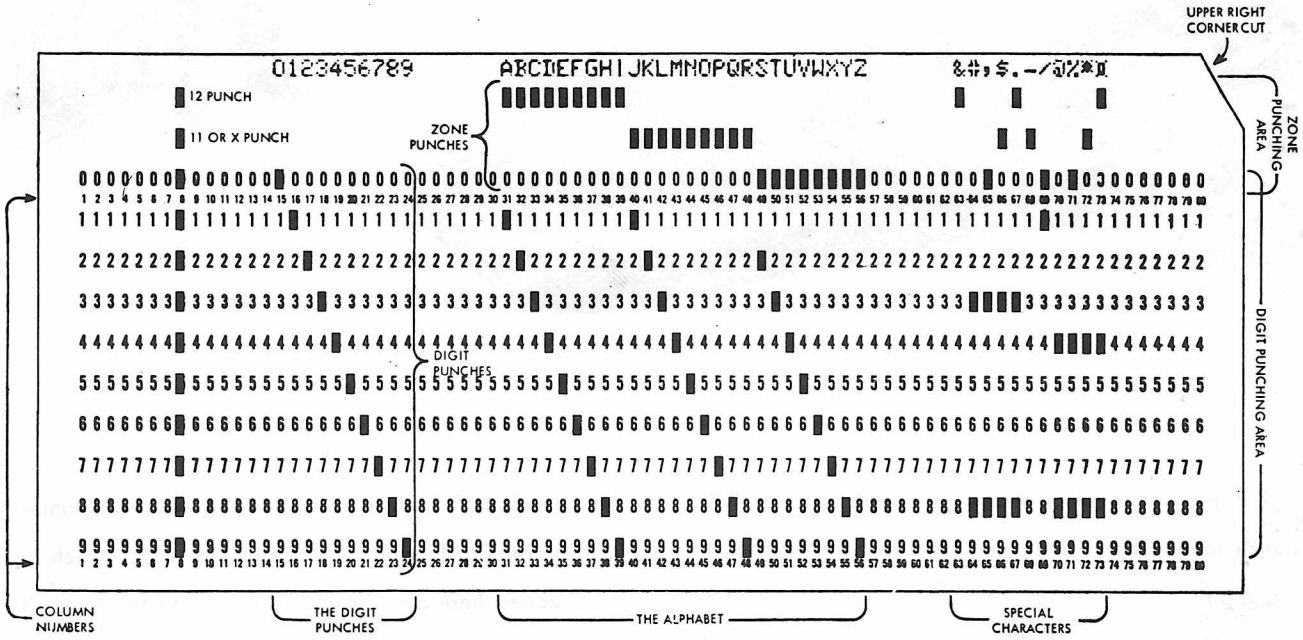
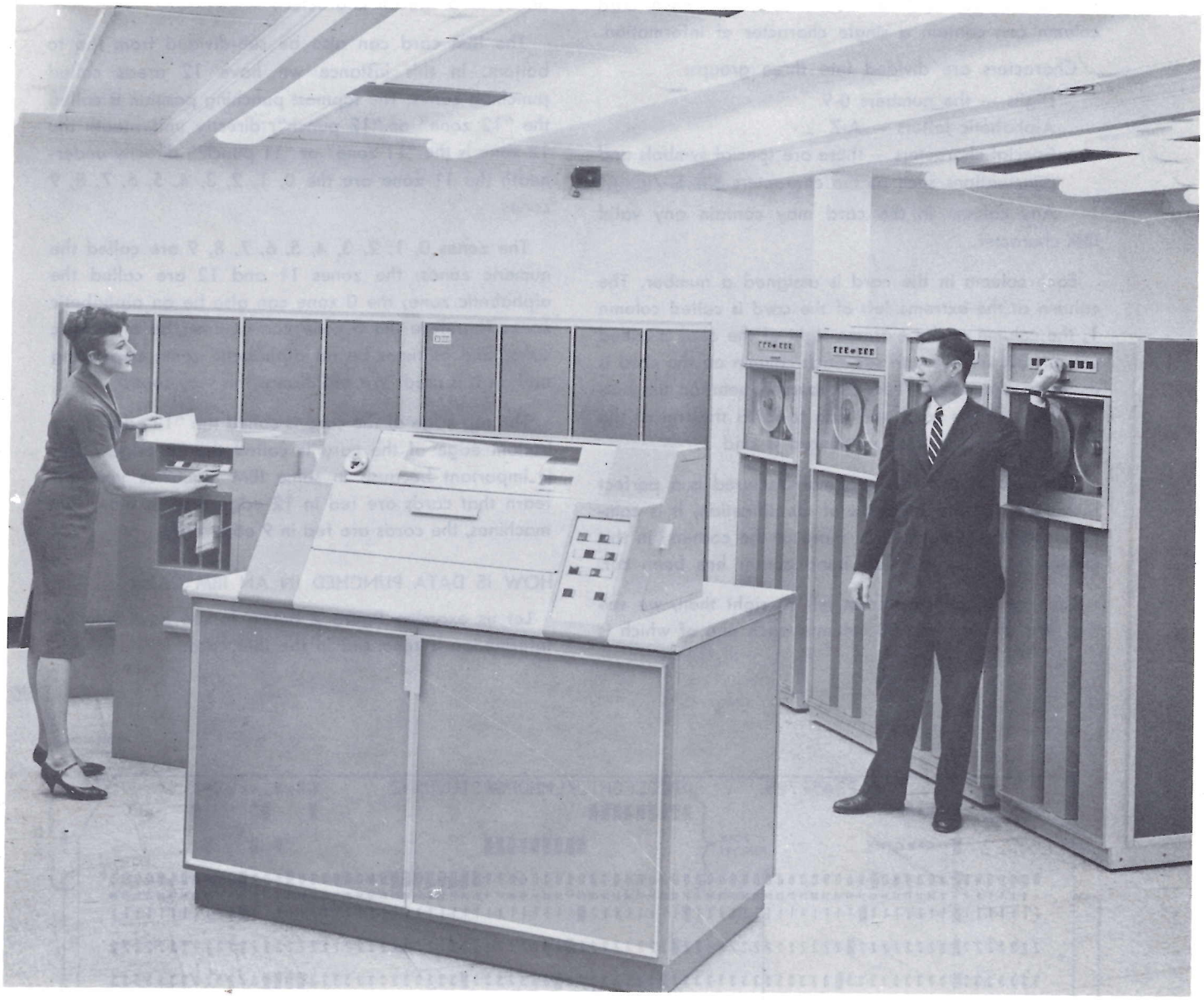


Fig. 2



The numeric digits 0-9 are recorded as a SINGLE punch in a column; the zone punched corresponds to the digit represented. By this we mean that the digit zero (0) is represented by a single punch in the zero zone; the digit one (1) is represented by a single punch in the one zone, etc. Looking at figure 2 you will see that the digits 0-9 have been punched in card columns 15 thru 24. Card column 24 contains a single punch in the 9 zone; therefore, this is interpreted to be the digit 9. This means that when this card is read by other IBM machines it will print the digit 9 from column 24 or add the digit 9 from column 24.

A single punch in a card column represents one of the digits 0-9. The digit represented corresponds to the particular zone that is punched. A single punch in the 11 zone is treated as the special symbol — (dash), see column 68; a single punch in the 12 zone is treated as the special symbol & (called an ampersand), see column 63.

Refer to figure 3 and answer the following questions. Place your answers to the right of the dash. When you have finished, refer to the back of this lesson for the correct answers.

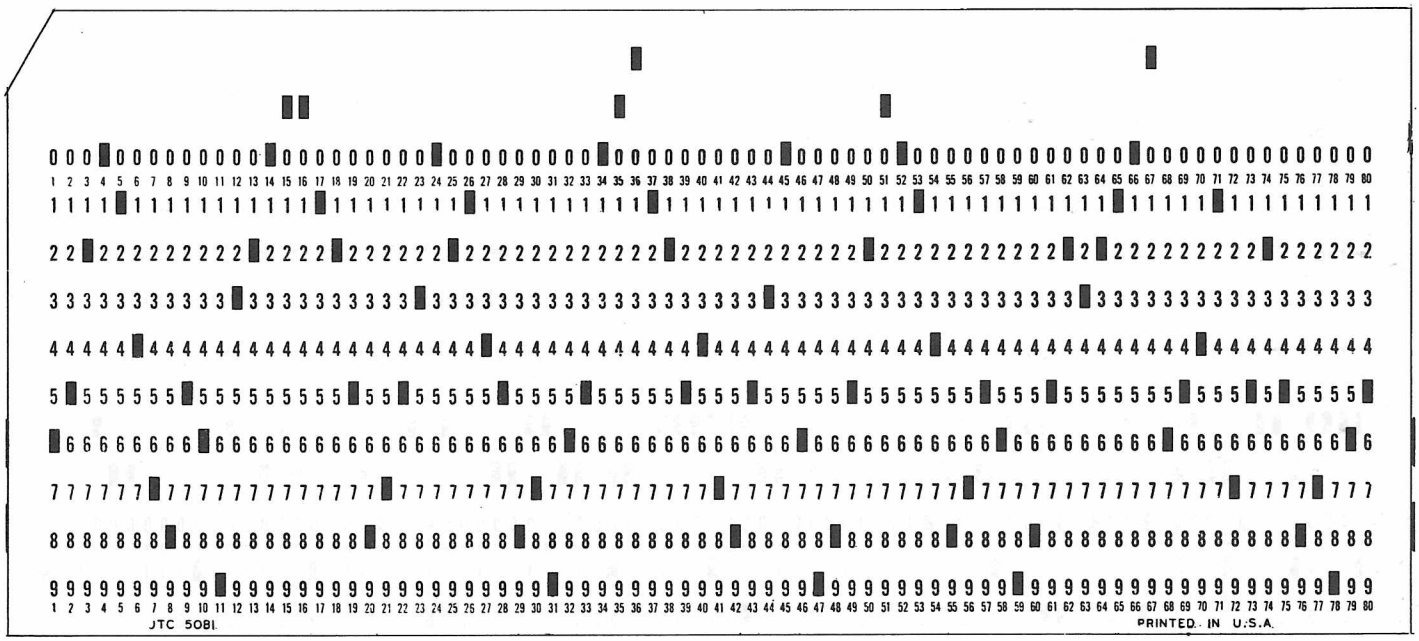


Fig. 3

Practice exercise 2-1:

What is the character in card columns:

32—	45—	67—	7—
4—	28—	76—	73—
16—	12—	13—	26—

If you are not satisfied with your answers for practice exercise 2-1, write your answers for practice exercise 2-2 below and refer to the back of this lesson for the correct answers.

Practice Exercise 2-2: (Use Fig. 3)

What is the character in card columns:

6—	33—	29—	54—
2—	52—	79—	20—
9—	41—	50—	70—

We have seen that digits are represented by a single punch in a card column. How then are alphabetic letters represented in IBM card code? Let us again examine figure 2 to see how alphabetic letters appear in the IBM card.

Each alphabetic letter is represented by a combination of 2 punches, one in the alphabetic zone (the 12, 11 or 0 zone); and one punch in the numeric zone (1-9). Here you can see that when the zero zone is punched in combination with another zone it becomes an alphabetic zone; when it appears by itself, it is a numeric zone (the digit 0).

We see therefore by examining card columns 31-39 that the letters A-I have in common a punch in the alphabetic zone 12. In addition to a punch in the alphabetic zone 12, they also have a punch in one of the numeric zones 1-9. The letter A is represented by punches in the 12 and 1 zone, the letter B is represented by punches in the 12 and 2 zones and so on until the letter I is represented by punches in the 12 and 9 zone. The letters J-R have in common a punch in the 11 zone and again some punch in the numeric zones 1-9; and the letters S-Z have in common a punch in the alphabetic zone zero (0) and also a punch in the numeric zones 2-9. You will note that each character in represented by a unique combination of punches; no two characters have the same card codes. This enables other IBM machines to distinguish one character from another.

In card columns 63-73 you will see the card codes for all the IBM special characters. Here we have some single digit codes (& and -), some two digit codes (# / @), and the balance of the special characters are represented by three digit codes.

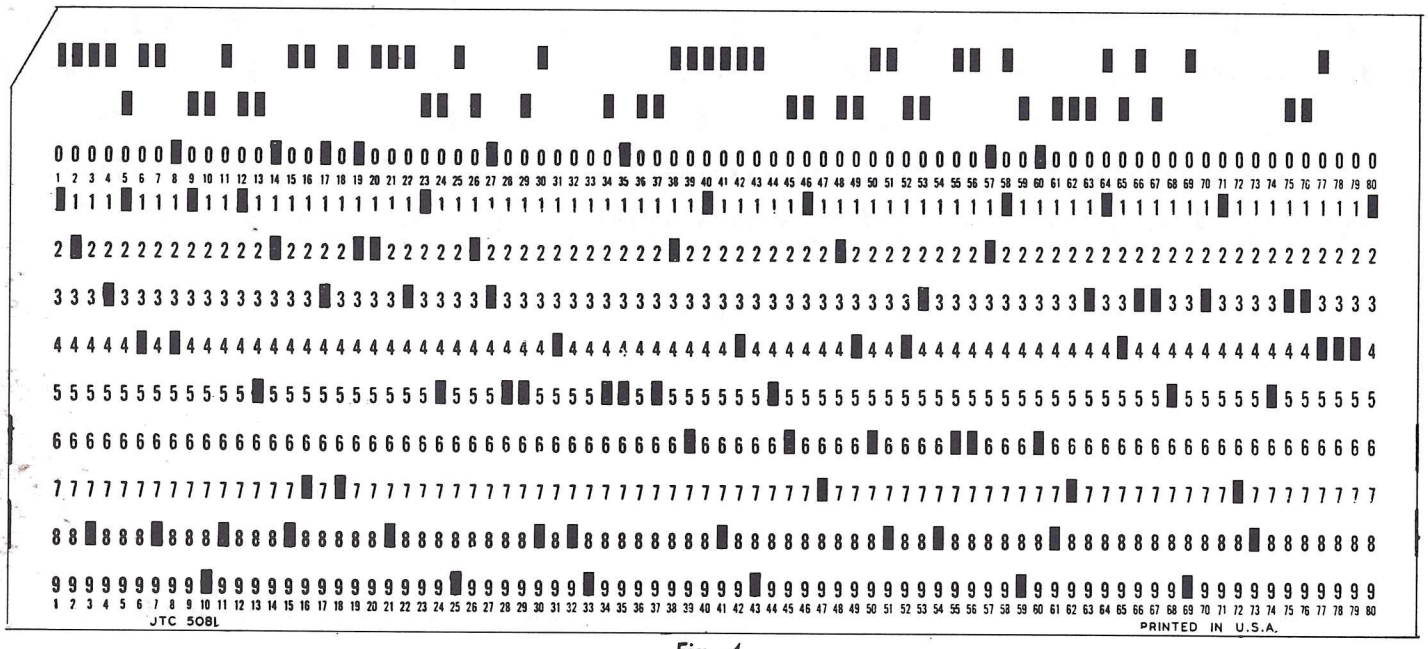


Fig. 4

Refer to figure 4 and answer the following questions. Place your answers to the right of the dash. When you have finished, refer to the back of this lesson for the correct answers.

Practice exercise 2-3:

What is the character in card columns:

32—	45—	66—	27—
34—	54—	17—	8—
2—	80—	76—	70—

2.3 I.B.M. Card Fields

We know that in order to use IBM Machines properly, the information to be processed must first be placed into cards, or as you will see, it is actually punched into cards using a machine called the card punch. In order to use the information in the cards we must know where in the cards the information is to be found (in what card columns has it been placed.)

Information is not punched into cards helter-skelter. It is punched in specially reserved areas called "fields". A field is defined as an area in the card (it may be 1 column, 2 columns or any number of columns) set aside to contain a specific type of information.

Refer to Figure 5. You will see that it is the standard Employee's Withholding Exemption Certificate that is filled out by an employee at the time he or she starts to work for a company. Now assume that we are required to punch some of the information which is contained on this certificate into an IBM card as part of a payroll procedure. The information which we are specifically interested in is the Employee's number which is to be found in the upper right hand corner of the certificate and the employee's name and Social Security No.

#683

FORM W-4 (Rev. June 1959)
U. S. Treasury Department
Internal Revenue Service

EMPLOYEE'S WITHHOLDING EXEMPTION CERTIFICATE

Print full name James W. Smith Social Security No. 102-88-9453

Print home address 1043 Main Street City New York Zone 68 State N. Y.

EMPLOYEE: File this form with your employer. Otherwise, he must withhold U. S. income tax from your wages without exemption.

EMPLOYER: Keep this certificate with your records. If the employee is believed to have claimed too many exemptions, the District Director should be so advised.

HOW TO CLAIM YOUR WITHHOLDING EXEMPTIONS

1. If SINGLE, and you claim an exemption, write the figure "1" . . . . . .
2. If MARRIED, one exemption each for husband and wife if not claimed on another certificate.
   (a) If you claim both of these exemptions, write the figure "2"
   (b) If you claim one of these exemptions, write the figure "1"
   (c) If you claim neither of these exemptions, write "0" 2
3. Exemptions for age and blindness (applicable only to you and your wife but not to dependents):
   (a) If you or your wife will be 65 years of age or older at the end of the year, and you claim this exemption, write "1"; if both will be 65 or older, and you claim both of these exemptions, write "2" . . . . . .
   (b) If you or your wife are blind, and you claim this exemption, write the figure "1"; if both are blind, and you claim both of these exemptions, write the figure "2" . . . . . .
4. If you claim exemptions for one or more dependents, write the number of such exemptions. (Do not claim exemption for a dependent unless you are qualified under instruction 4 on other side.) 2
5. Add the number of exemptions which you have claimed above and write the total 4
6. Additional withholding per pay period under agreement with employer. *See* Instruction 1 . . . . . $

Fig. 5

Now refer to Figure 6 to see how fields are set aside in the card to contain this information.

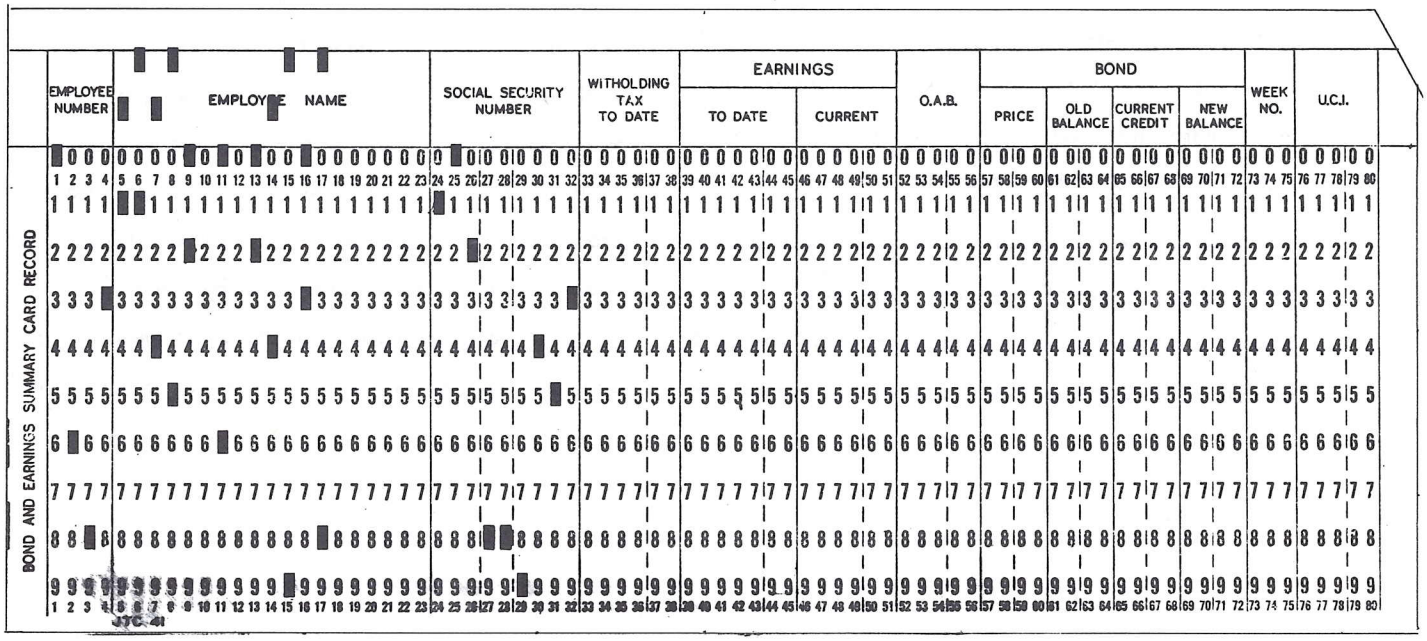


Fig. 6

Three fields have been set aside in Figure 6 to contain the information found in Figure 5. Columns 1-4 are set aside as a field called "employee number"; columns 5-23 is a field called "employee name"; and columns 24-32 is a field called "social security number". Note that the number of columns to be set aside for a field is determined by a system study of the job to be done. Fields are laid out in advance to accommodate the maximum number of characters expected.

Those fields which contain only digits are called "numeric" fields; fields which contain alphabetic or special characters are called "alphabetic" fields. Numeric fields and alphabetic fields are similar in some respects and different in others. Let us first look at the similarities.

The right-most position of any field is referred to as the "units" or "low-order" position. To the left of the units position, we have the "tens" position, then the "hundreds" than the "thousands" and so on. The left-most position in a field is referred to as the "high-order" position.

Refer to the "employee number" field in Figure 6. The units position of this field is column 4; the high-order position is column 1. The units position of the "employee name" field is column 23; the high-order position is column 5. The units position of the "social security" field is column 32; the high-order position is column 24.

How do numeric fields differ from alphabetic fields? They differ in the way that they are punched. In numeric fields, if the number to be punched is shorter then the field, zeros are added to the left until the number equals the field size. For example, the employee number in Figure 5 (upper right hand corner) is punched as 0683 in column 1-4 of Figure 6. If the employee number had been 24, it would have been punched as 0024; if it had been 7, it would have been punched as 0007.

Alphabetic fields are punched starting in the high-order position and unused columns are left blank. Note that punctation is omitted entirely in both the "employee name" and "social security number" fields.

Figures 7 and 8 illustrate another Employee's Exemption Certificate and the way it would be punched. Examine them.

FORM W-4 (Rev. June 1959)
U. S. Treasury Department
Internal Revenue Service

EMPLOYEE'S WITHHOLDING EXEMPTION CERTIFICATE # 1456

Print full name Henry H. Simmons Social Security No. 145-67-0090

Print home address 657 Broadway, New York, N. Y. City ..... Zone ..... State .....

EMPLOYEE:
File this form with your employer. Otherwise, he must withhold U. S. income tax from your wages without exemption.

EMPLOYER:
Keep this certificate with your records. If the employee is believed to have claimed too many exemptions, the District Director should be so advised.

HOW TO CLAIM YOUR WITHHOLDING EXEMPTIONS 1

1. If SINGLE, and you claim an exemption, write the figure "1" . . . . . .
2. If MARRIED, one exemption each for husband and wife if not claimed on another certificate.
   (*a*) If you claim both of these exemptions, write the figure "2"
   (*b*) If you claim one of these exemptions, write the figure "1"
   (*c*) If you claim neither of these exemptions, write "0" . . . . . .
3. Exemptions for age and blindness (applicable only to you and your wife but not to dependents):
   (*a*) If you or your wife will be 65 years of age or older at the end of the year, and you claim this exemption, write "1"; if both will be 65 or older, and you claim both of these exemptions, write "2" . . . . . .
   (*b*) If you or your wife are blind, and you claim this exemption, write the figure "1"; if both are blind, and you claim both of these exemptions, write the figure "2" . . . . . .
4. If you claim exemptions for one or more dependents, write the number of such exemptions. (Do not claim exemption for a dependent unless you are qualified under instruction 4 on other side.) . . . . . .
5. Add the number of exemptions which you have claimed above and write the total 1
6. Additional withholding per pay period under agreement with employer. *See* Instruction 1 . . . . . $.....

Fig. 7

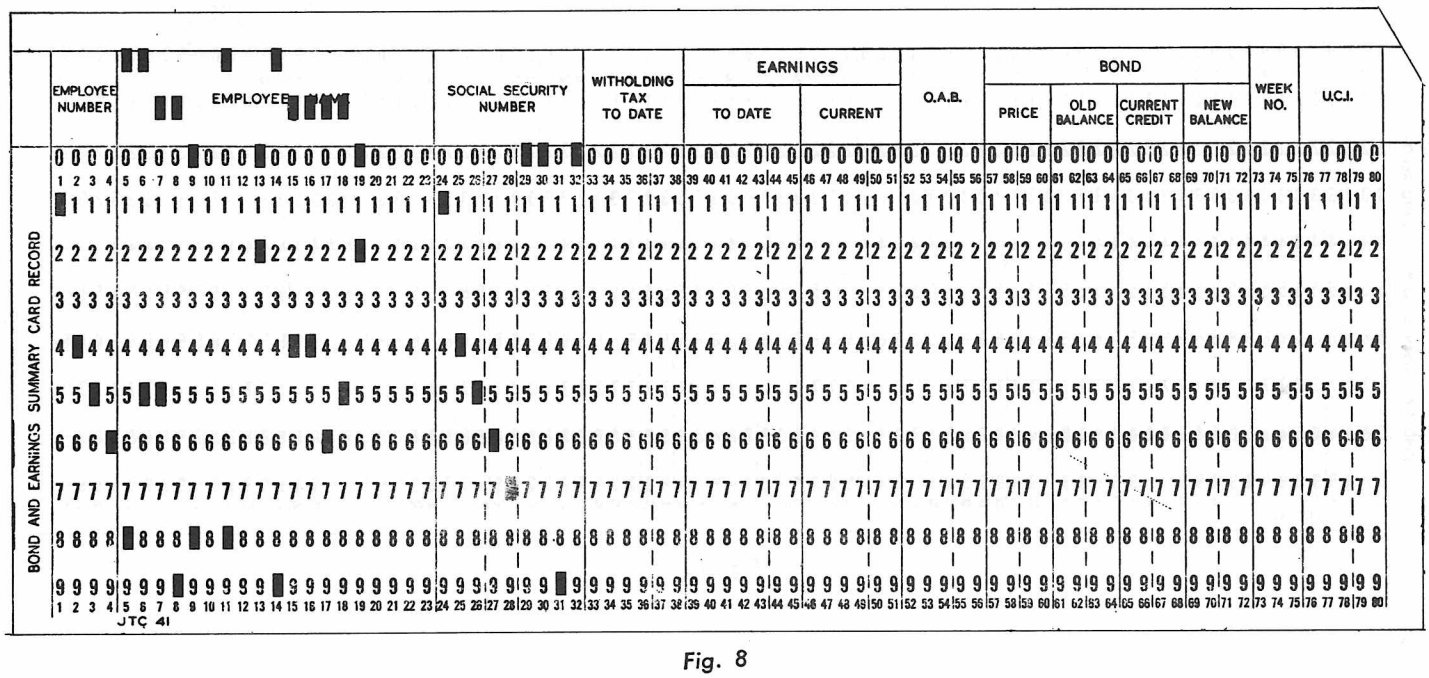


Fig. 8

Practice exercise 2-4:

Figure 9 illustrates an Employee's Exemption Certificate. Use a pencil and mark on Figure 10 the columns which would be punched (blacken the numeric and alphabetic zones). When you have finished, refer to the back of this lesson for the correct answer.

FORM W-4 (Rev. June 1959)
U. S. Treasury Department
Internal Revenue Service

EMPLOYEE'S WITHHOLDING EXEMPTION CERTIFICATE # 46

Print full name John Meriden Social Security No. 156-90-0076

Print home address ..... City ..... Zone ..... State .....

EMPLOYEE: File this form with your employer. Otherwise, he must withhold U. S. income tax from your wages without exemption.

EMPLOYER: Keep this certificate with your records. If the employee is believed to have claimed too many exemptions, the District Director should be so advised.

HOW TO CLAIM YOUR WITHHOLDING EXEMPTIONS

1. If SINGLE, and you claim an exemption, write the figure "1" 1
2. If MARRIED, one exemption each for husband and wife if not claimed on another certificate.
   (*a*) If you claim both of these exemptions, write the figure "2"
   (*b*) If you claim one of these exemptions, write the figure "1"
   (*c*) If you claim neither of these exemptions, write "0" . . . .
3. Exemptions for age and blindness (applicable only to you and your wife but not to dependents):
   (*a*) If you or your wife will be 65 years of age or older at the end of the year, and you claim this exemption, write "1"; if both will be 65 or older, and you claim both of these exemptions, write "2" . . . .
   (*b*) If you or your wife are blind, and you claim this exemption, write the figure "1"; if both are blind, and you claim both of these exemptions, write the figure "2" . . . .
4. If you claim exemptions for one or more dependents, write the number of such exemptions. (Do not claim exemption for a dependent unless you are qualified under instruction 4 on other side.) . . . .
5. Add the number of exemptions which you have claimed above and write the total 1
6. Additional withholding per pay period under agreement with employer. *See* Instruction 1 . . . . . $.....

Fig. 9

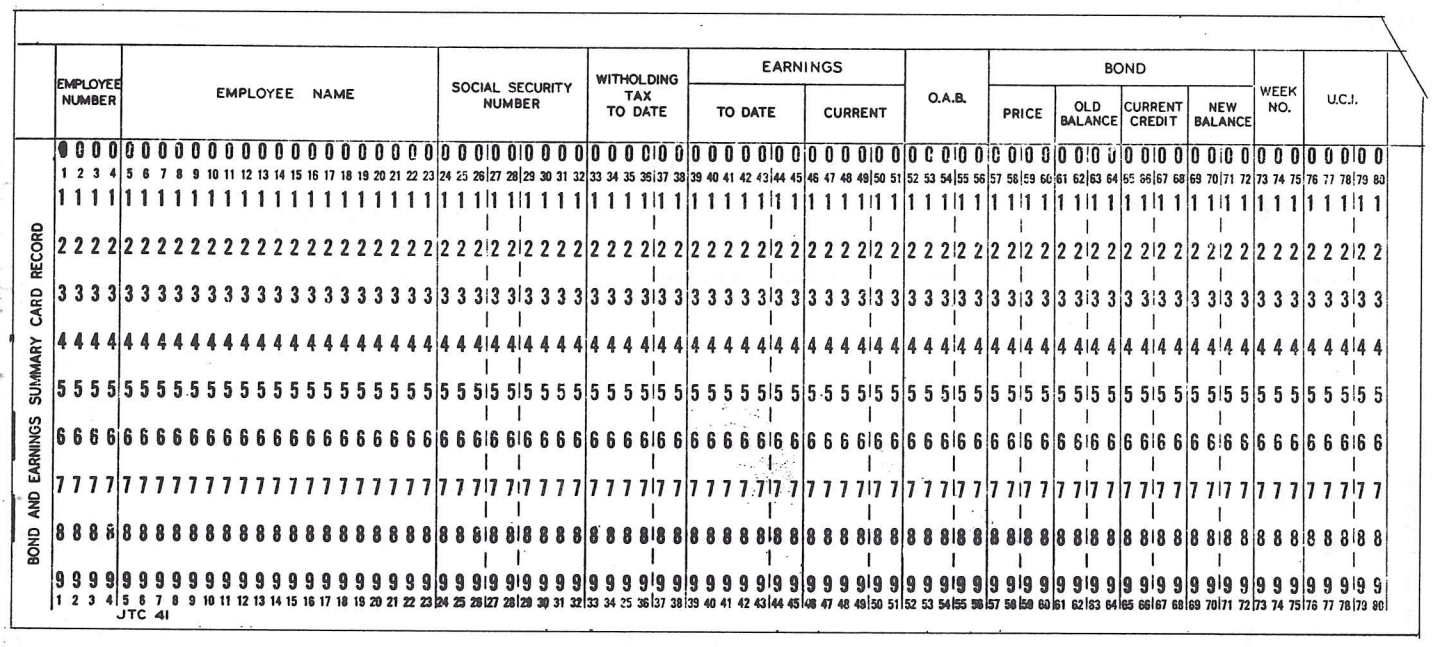


Fig. 10

2.4 Distinguishing Between Types of Cards

IBM Cards may be printed in any color or may have different types of corner cuts. This may help the operator to tell them apart, but the machines cannot see colors or feel corner cuts. In order for the machine to tell the difference between types of cards, they must have a "control" punch somewhere in the card. The control punch may be anywhere in the card, in any column, or punched in any of the 12 punching positions. It is most common however, to use an "11" (x) punch as a control punch.

Note that Figures 11 & 12 illustrate two cards which seem to be alike. However, the card in Figure 12 contains a control punch (an X in Column 53) The card in Figure 11 might be a "sales" card; and the card in Figure 12 might be a "return" card. They would be handled differently by the IBM machines based upon the presence or absence of the control punch in column 53. The use of control punching will be explained in greater detail in later lessons.

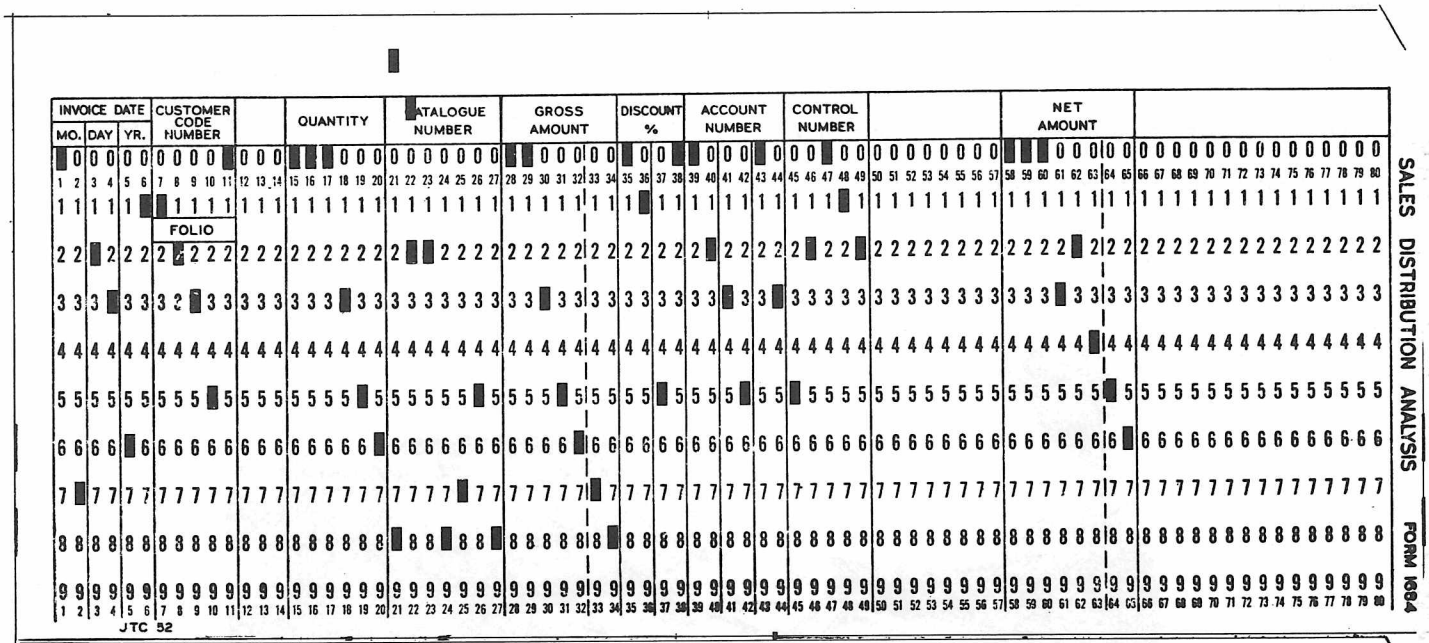


Fig. 11

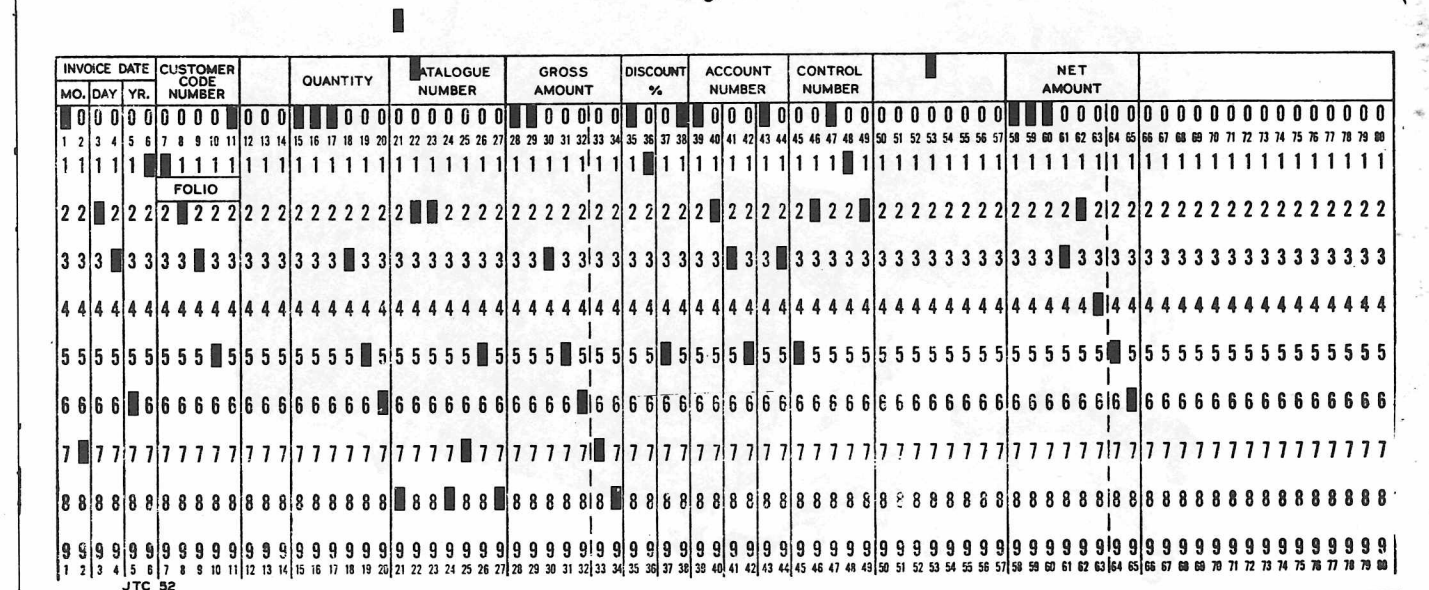


Fig. 12

GLOSSARY

Alphabetic character — the letters in the alphabet A-Z

Alphabetic field — contains alphabetic characters; may also contain numeric characters.

Card column — One of the 80 vertical divisions of a card. Each card column may contain 1 character of information, either a digit, alphabetic letter, or special character.

Control Punch — used to distinguish between cards. May be any punch in any position, but it usually an "x" punch.

Corner cut — Any of the 4 corners of the IBM card may be cut off for operator identification.

Digits — the numbers 0-9

Field — A column or group of columns set aside in the card to contain type of information.

High-order position — the left-most position in a field

Low-order position — same as units position

Numeric Characters — the digits 0-9

Numeric field — contains only digits.

Special characters — special symbols and punctuation.

Units position — the right-most position in a field

Zones — there are 12 horizontal punching zones in the card, 10 numeric zones (0-9) and 3 alphabetic zones (12, 11 and 0). The zero zone is a dual purpose zone.

9 Edge — the bottom of the card.

12 Edge — the top of the card.

ANSWERS TO PRACTICE EXCERCISES

Practice Exercise 2.1

Correct Answers:

32 — digit 6
4 — digit 0
16 — "x" punch (Zone 11)
45 — digit 0
28 — digit 5
12 — digit 3
67 — "12" zone
76 — digit 8
13 — digit 2
7 — digit 7
73 — digit 5
26 — digit 1

Practice Exercise 2.2

Correct Answers:

6 — digit 4
2 — digit 5
9 — digit 5
33 — digit 5
52 — digit 0
41 — digit 7
29 — digit 8
79 — digit 6
50 — digit 2
54 — digit 4
20 — digit 8
70 — digit 4

Practice Exercise 2.3

32 — digit 8
34 — letter N
2 — letter B
45 — letter O
54 — digit 8
80 — digit 1
66 — letter C
17 — letter T
76 — letter L
27 — letter T
8 — letter U
70 — digit 3

Practice Exercise 2.4

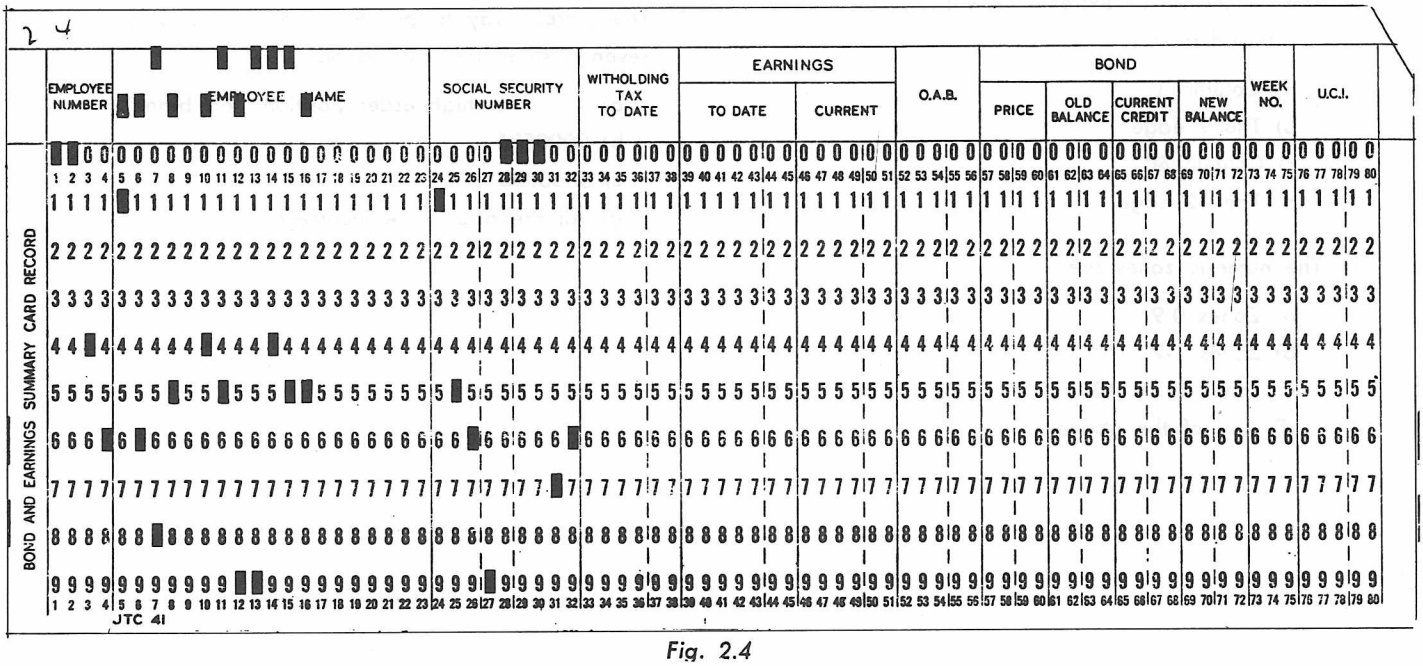


Fig. 2.4

LESSON TWO — EXAMINATION

There will be an examination at the end of each lesson for the material covered. Circle the correct answer to each question and then carefully transfer these answers to the Examination Answer Blank by placing an X in the correct box. Be sure to answer all the questions before using the Answer Blank. **Read all the answers before selecting one.**

Fill in all the information requested in the blank spaces which you will find on both sides of the Examination Answer Blank, (Name, Address & Student Number.) Upon completing and answering all questions, fold the card in thirds, with the Institute's return address facing out, and place a four-cent stamp in the upper right hand corner. No envelope is necessary. Mail each Answer Blank in consecutive order for grading and correction.

Seal with a small piece of scotch tape in the center of the open edge to insure its safe arrival at the Institute. DO NOT SEAL THE ENTIRE EDGE OF THE ANSWER BLANK.

EXAMINATION

1. The standard IBM card:
   a) Has 13 punching zones
   b) Has 80 columns
   c) Requires 2 columns for an alphabetic character
   d) Answers a-c are all correct

2. The column at the extreme right edge of the card is referred to as:
   a) Column 1
   b) The 9 edge
   c) Column 80
   d) The 12 edge

3. The numeric zones are
   a) Zones 0-9
   b) Zones 1-9
   c) Zones 11 & 12
   d) Any of the above

4. The alphabetic zones are
   a) Zones 11 & 12
   b) Zones 1-9
   c) Zones 0
   d) Zones 12, 11 & 0

5. The correct way to punch the number 536 in a seven position field would be:
   a) 536 (high order positions left blank)
   b) 0000536
   c) 5360000
   d) All the above are incorrect

6. The correct way to punch the number 3236 in a six position field would be:

   a) 3236 (high-order positions left blank)
   b) 032360
   c) 323600
   d) All the above are incorrect

7. The name Joe Smith is to be punched in a field defined as columns 10-24.

   a) Column 24 is called the high-order position
   b) Column 24 would be punched with the letter "h"
   c) Column 10 would be punched with the letter "J"
   d) Answers a-c are all incorrect

8. A "field" can be:

   a) One column in length
   b) Eighty columns in length
   c) Any number of columns in length
   d) Answers a-c are all correct

9. An "x" punch:

   a) Is usually used as a control punch
   b) Is an alphabetic zone
   c) Is found in all the alphabetic letters J-R
   d) Answers a-c are all correct

10. Refer to the figure 13 below.

   a) The numeric field quantity in columns 15-20 is punched correctly. The number is 423
   b) The numeric field catalogue number in columns 21-27 is punched incorrectly. The number is 68792
   c) The numeric field control number in columns 45-49 is punched correctly. The number is 7890.
   d) Answers a-c are all false.

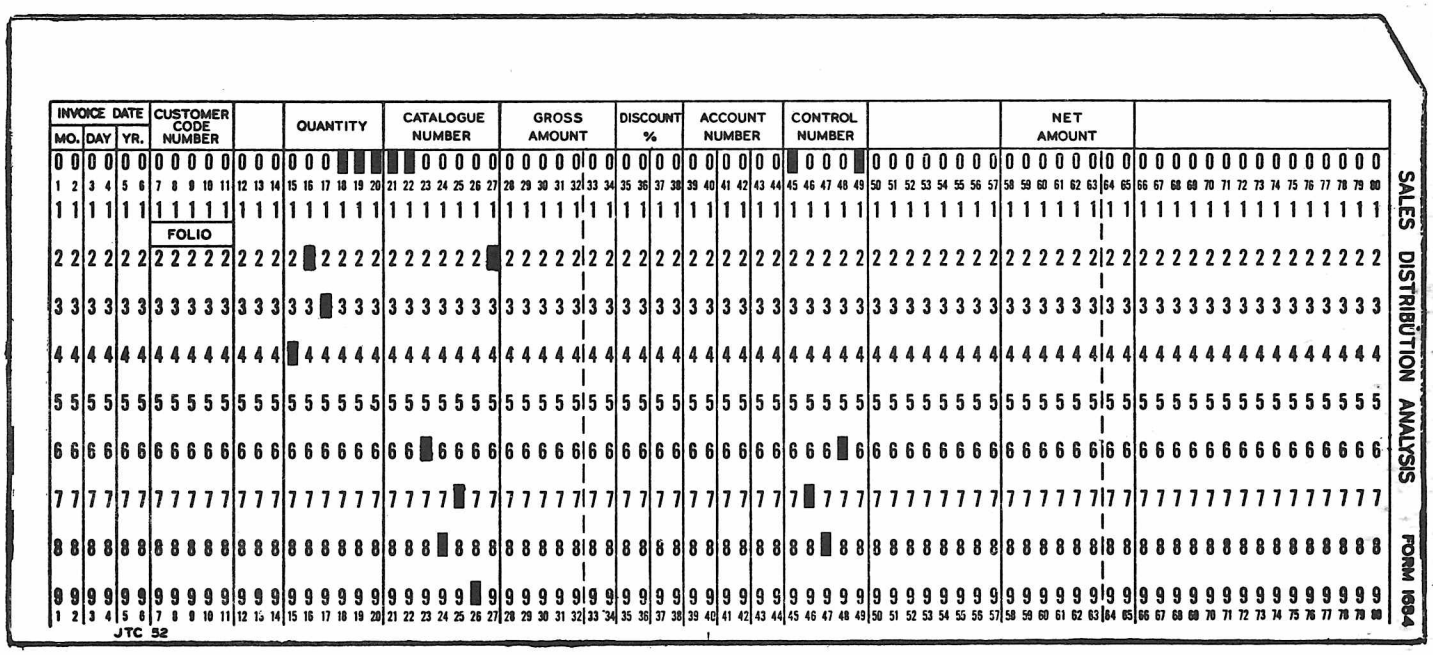


Fig. 13

I.B.M. DATA PROCESSING AND COMPUTER PROGRAMMING

LESSON #3

TABLE OF CONTENTS

3.1) The IBM 024 Card Punch
Operating Features

3.2) The Keyboard
Description of card punching procedures

3.3) Three Basic Card Punch Operations
Punching individual fields; Correcting error cards;
Re-punching damaged cards

3.4) The Punch Mechanism

3.5) Summary
Glossary
Examination

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ELECTRONIC COMPUTER PROGRAMMING INSTITUTE

PREFACE

In the lessons that follow, we will be concerned with learning how various types of I.B.M. machines function. In this lesson we will study the I.B.M. Card Punch, the machine used to initially create the IBM card. In future lessons we will study the Interpreter, the Sorter, the Reproducer, the Collator, and the Accounting Machine.

The IBM card is certainly the most important element in the entire I.B.M. Data Processing concept. In order for IBM machines to be able to process data, this data must first be placed into an IBM card. How this is accomplished will be the subject of lesson 3.

We will be particularly concerned with the three card punch operations which are of importance to I.B.M. Punched Card Technicians and Computer Programmers: (1) Punching individual fields and control punches; (2) Correcting cards which contain errors; (3) Re-punching cards which are damaged

IBM CARD PUNCH

The first step in the IBM procedure is to record data into punched cards. The data is initially found in what we will call the "source document." The information found on this source document is what we are going to place in the IBM card. Illustrated below is a typical source document (Figure 1), one which you will remember was used in lesson 2. Below the source document in Figure 2 you will see illustrated the IBM card which was created from this source document. The information in the source document and in the card is exactly the same — the only difference is that in the source document the information is written in English, the language you and I understand; and in the IBM card, the information is written in IBM card code form, the language that all other IBM machines understand. The question is: how is the information in the source document translated into IBM card code? The answer is: by using the IBM Card Punch.

FORM W-4 (Rev. June 1959)
U. S. Treasury Department
Internal Revenue Service

EMPLOYEE'S WITHHOLDING EXEMPTION CERTIFICATE

986

Print full name Robert Allan Social Security No. 165 - 89 - 6782

Print home address ..... City ..... Zone ..... State .....

EMPLOYEE:
File this form with your employer. Otherwise, he must withhold U. S. income tax from your wages without exemption.

EMPLOYER:
Keep this certificate with your records. If the employee is believed to have claimed too many exemptions, the District Director should be so advised.

HOW TO CLAIM YOUR WITHHOLDING EXEMPTIONS

1. If SINGLE, and you claim an exemption, write the figure "1" 1
2. If MARRIED, one exemption each for husband and wife if not claimed on another certificate.
   (*a*) If you claim both of these exemptions, write the figure "2"
   (*b*) If you claim one of these exemptions, write the figure "1"
   (*c*) If you claim neither of these exemptions, write "0" . . . .
3. Exemptions for age and blindness (applicable only to you and your wife but not to dependents):
   (*a*) If you or your wife will be 65 years of age or older at the end of the year, and you claim this exemption, write "1"; if both will be 65 or older, and you claim both of these exemptions, write "2" . . . .
   (*b*) If you or your wife are blind, and you claim this exemption, write the figure "1"; if both are blind, and you claim both of these exemptions, write the figure "2" . . . .
4. If you claim exemptions for one or more dependents, write the number of such exemptions. (Do not claim exemption for a dependent unless you are qualified under instruction 4 on other side.) . . . .
5. Add the number of exemptions which you have claimed above and write the total 1
6. Additional withholding per pay period under agreement with employer. *See* Instruction 1 . . . . . $.....

I CERTIFY that the number of withholding exemptions claimed on this certificate does not exceed the number to which I am entitled.

(Date) ....., 19..... c48—16—70611-3 (Signed) .....

Figure 1. A Typical Source Document

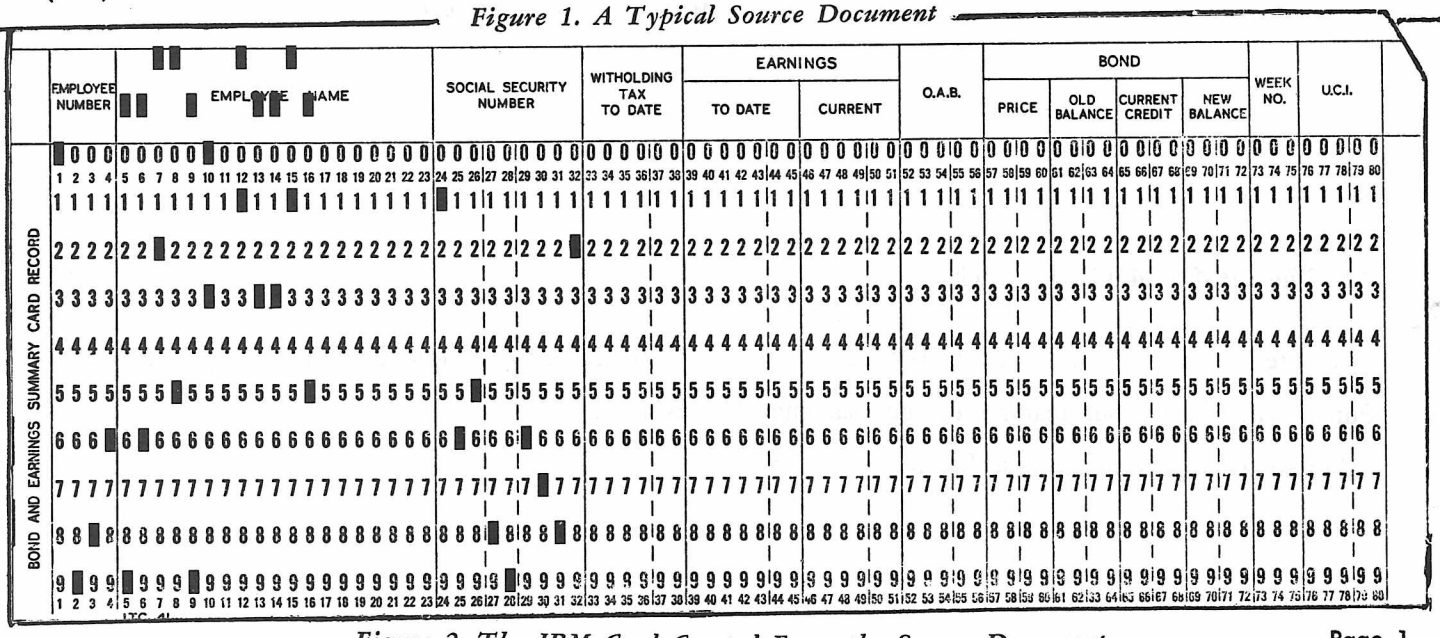


Figure 2. The IBM Card Created From the Source Document

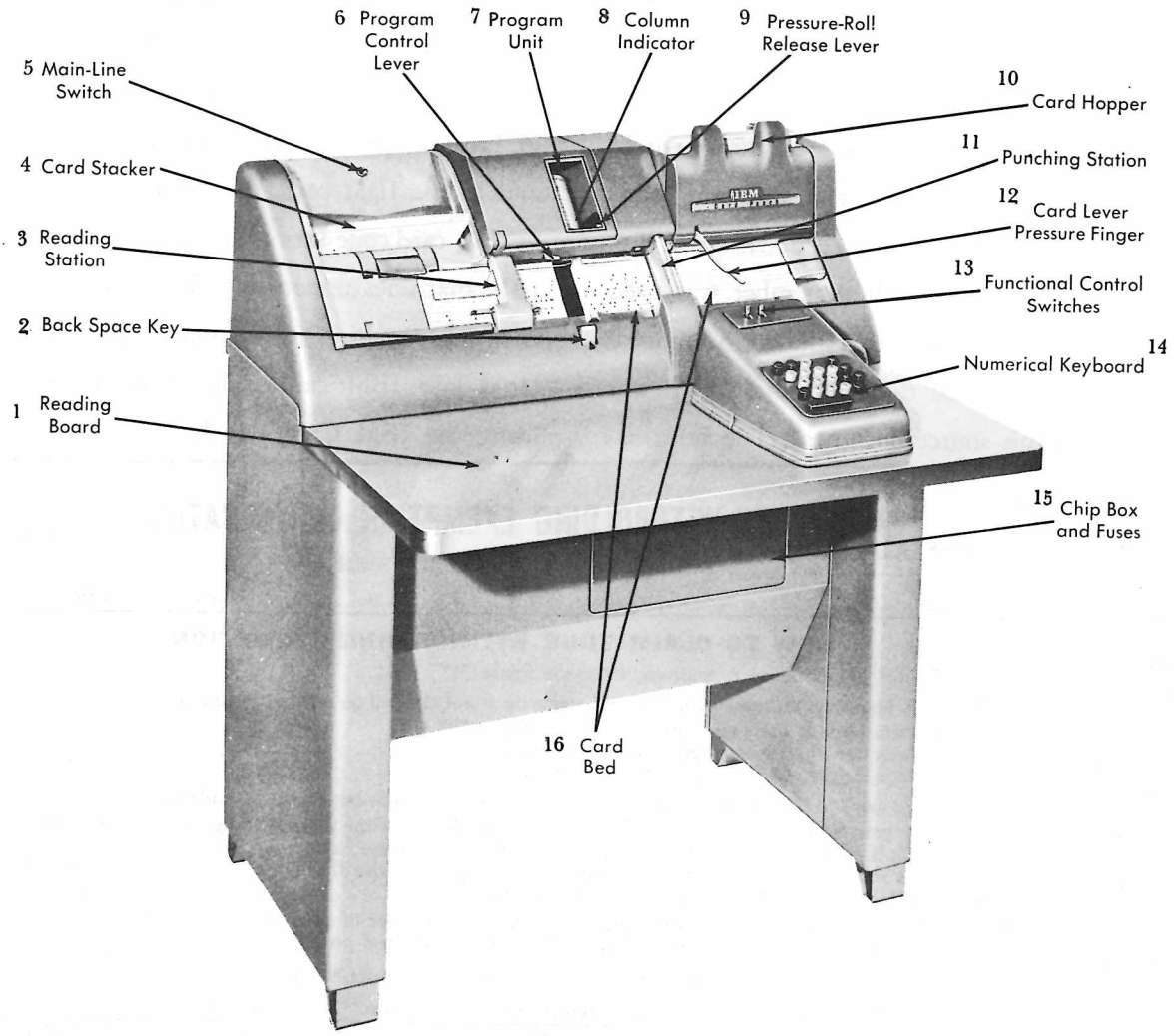


Figure 3. The I.B.M. type 024 Card Punch

3.1 The IBM 024 Card Punch

Figure 3 is an illustration of the IBM 024 Key Punch with the various features of the machine indicated. Let us examine these features in order of their use to see how this machine operates and is used.

1. *Reading Board*—The operator will sit at the machine. The source documents are placed in front of the operator on the reading board for easy reference.

5. *Main Line Switch*—When the machine is not in use this switch will be up. As you are ready to start punching this switch is flipped down and this will send electricity into the machine. A few minutes wait will be required before the card punch is ready for use as the machine has tubes which must warm up. Then the machine is ready for punching.

10. *Card Hopper*—The card hopper has a capacity for approximately 500 cards. Cards are placed in the hopper with the printed side facing you and the "9 edge" down. The first 2 cards to be punched are fed into the machine by depression of the card feed key. The function of this key and its operation will be discussed in detail later on.

14. *Keyboard*—Depressing the keys on the keyboard is what causes the card to be punched. There are different types of keyboards. The Numerical Keyboard is illustrated in Figure 4, the Combination Alphabetic and Numerical Keyboard is illustrated in Figure 5. The operation of the keyboard will be discussed in detail later on.

Figure 4. Numerical Keyboard

Figure 5. Combination Alphabetic & Numerical Keyboard

11. *Punching Station*—When the "card feed" key on the keyboard is depressed a card is fed and is positioned under the punching station. The card is punched from left to right so that the first column to be punched is Column 1. As a key on the keyboard is depressed, a column is punched and the card then moves automatically to the next column to be punched.

3. *Reading Station*—After the card has been punched, it will then be positioned at the reading station and the next card will be positioned at the punching station. As you punch the second card (which is at the punching station), the machine is reading what was punched in the first card (at the reading station.) It is possible to read information from the card which is passing under the reading station and cause this same information to be punched into the card that is under the punch station by using the "duplicate key." The duplicate key will be discussed again in the next section of this lesson.

2. *Backspace Key*—As you are punching, it may be necessary to go back to a column that was missed. By holding down the backspace key, the cards at the punch and read stations move backwards until you reach the desired column.

4. *Card Stacker*—After the card has left the reading station, it enters the card stacker. These cards are held in position by a card weight until the operator removes them. They are then in the same sequence as the source documents.

8. *Column Indicator*—As the cards are moving under the punching and reading station, a column indicator will tell you the number of the column which is ready to be punched. See Figure 6 for a closeup.

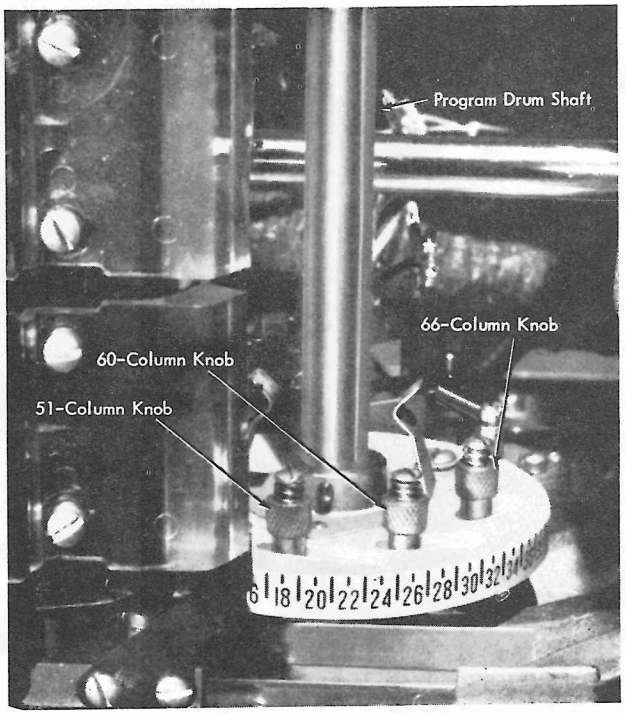


Figure 6. The Column Indicator

IBM

9. *Pressure-Roll Release Lever*—It is possible that while punching a card, a machine malfunction will cause the card to jam so that it cannot continue to be fed. The card can then be removed from the punching station by holding down the Pressure-Roll Release Lever and manually pulling the card out.

7. *Program Unit*—Ordinarily, punching, skipping, spacing and stacking are controlled from the keyboard. In special situations, these functions can be controlled by the machine using what is called a program drum. This drum would be placed inside the Program Unit.

6. *Program Control Lever*—In order to use the Program Unit, the program control lever must be turned down.

13. *Functional Control Switches*—Two switches control automatic feeding and duplicating when it is not desirable to control these operations from the keyboard.

15. *Chip Box and Fuses*—As the card is being punched, little paper chips are created (like confetti.) These are stored in the chip box. Behind the chip box are the fuses for the card punch. The chip box can be removed and emptied and fuses replaced easily.

3.2 The Keyboard

There are two types of keyboards. The numerical keyboard, Figure 4, contains keys which permit you to punch only the 10 digits, 0-9 and the other 2 zones, the 11 or "x" zone and the 12 zone. The combination alphabetic and numerical keyboard, Figure 5, permits you to punch all the digits, alphabetic letters and special characters.

At the top of the combination alphabetic and numerical keyboard you will notice three switches. The first switch to the left is the *Auto Feed* switch. When this switch is on (flipped up) feeding and stacking of cards is automatic as each card is processed and released from the keyboard. The switch in the middle is called the *Auto Skip Auto Dup* switch. When it is ON, automatic skipping from field to field in the card and automatic duplicating of special information is under the control of the program unit, (see feature 7 on the card punch.) The last switch on the right is optional. That is, it is not found on all machines. When it is ON, the card punch will print on the top of the card the information being punched into the card. See Figure 7 for an illustration of a card punched and printed.

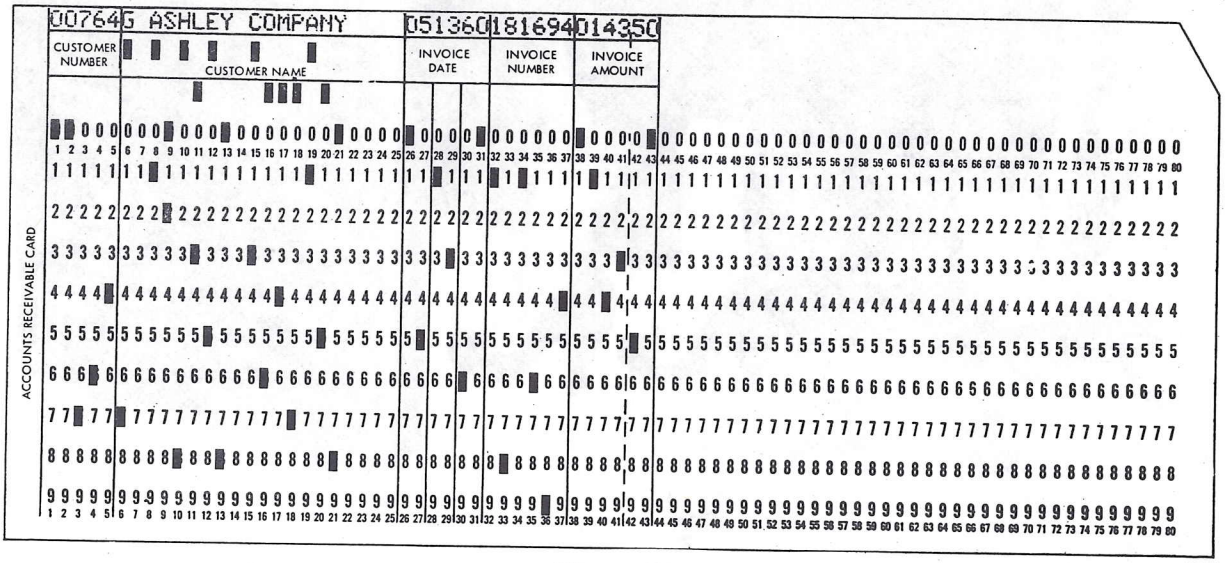


Figure 7.

IBM

We will now examine in detail the keyboard illustrated in chart form in Figure 8.

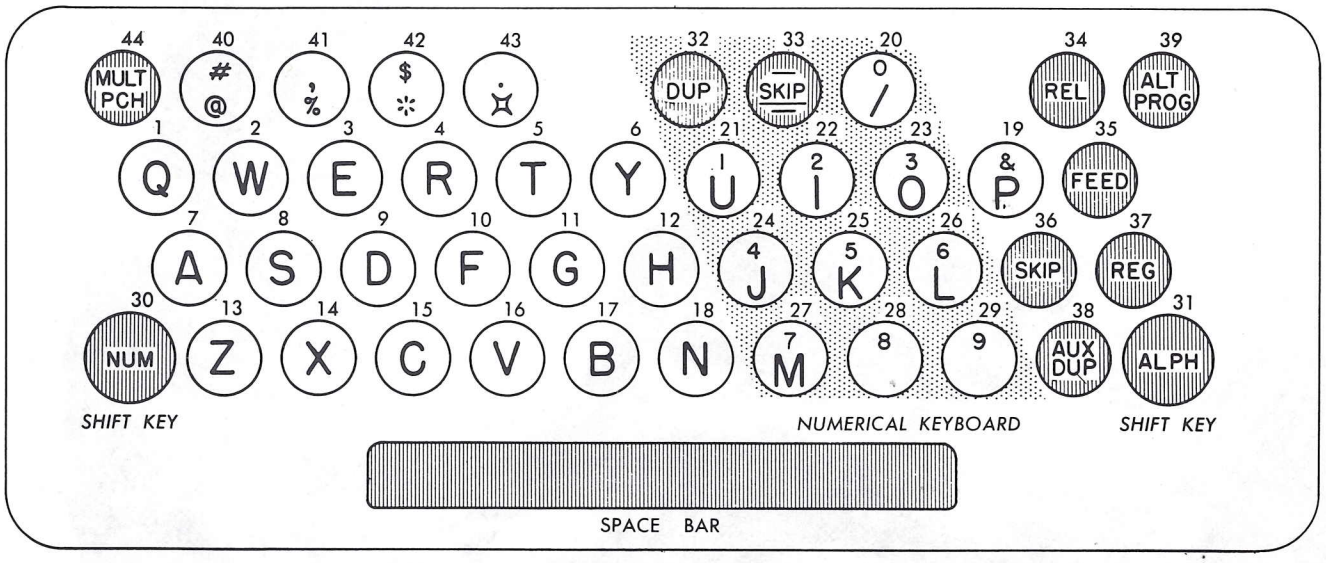


Figure 8. Keyboard Chart

Most of the information punched into IBM cards is numerical in nature. Note that the keyboard is set up very much like a typewriter insofar as the alphabetic letters are concerned. The numbers (found on keys 20-29) are set up like an adding machine. This permits the operator to punch numbers using the right hand only, and leaving the left hand free to handle the source documents.

The keys on this chart have been numbered for reference purposes. Note that keys 1-19 and 21-27 contain the letters of the alphabet. Key 20 is a special symbol called a slash (/). Normally, this machine is in alphabetic status. By that I mean that should you depress key 21, the machine would punch the IBM code for the letter U; however, you can see that key 21 also contains on its face the digit 1. How then do you cause the machine to punch the digit 1 rather than the letter U. The answer is fairly simple. Direct your attention to key 30. This is the numeric shift key. When this key is depressed the machine changes from alphabetic status to numeric status. Therefore, to punch the digit 1, do 2 things:

1. Depress key 30 using the left hand.
2. Then depress key 21 using the right hand.

When the shift key (30) is pressed, the numbers 0-9 can be punched with keys 20-29; also, with the shift key depressed, the Skip key (33) will punch an 11 punch in the card, and key 19 will punch a 12 punch in the card. Keys 40-43 are for the special characters. With the shift key depressed, the upper row of characters will be punched; without the shift key depressed, the lower row of characters will be punched.

Let us now examine in detail the necessary steps required to punch a card. We will punch the card illustrated in Figure 2 from the source document illustrated in Figure 1.

a) The Main Line Switch is ON, the cards are in the card hopper, and the machine is warmed up, ready for use.

b) Depress the Feed Key (35) and the first card feeds from the card hopper to the punch station.

c) Depress the Register Key (37) and the card now in the punch station is shifted to the left to be registered for punching. Should we inspect the column indicator, we would see that it was at column 1 which is, of course, the first column to be punched.

d) Now we can begin punching. Note that the first field (Columns 1-4, Employee Number) is a numeric field and that the employee number is 986. Since this is a 4-position field, it is to be punched 0986.

e) Press the Shift Key (30) to place the machine in numeric status, and while holding this key down with the left hand, press the 0 key (20). This punches a zero in column 1 and moves the card automatically to the left (much like a typewriter) so that column 2 is ready to be punched.

f) Still holding the Shift Key down, press the 9 key (29) to punch a 9 in column 2; then the 8 key (28) to punch an 8 in column 3; and then the 6 key (26) to punch a 6 in column 4.

CONSOLE CHECK
HONEYWELL 1800

g) The first field (employee number 0986) has now been punched and the column indicator is on column 5, the first column of the next field, Employees Name.

h) Since Employee Name is an alphabetic field, release the Shift Key which places the card punch in alphabetic status. Now press the following keys in sequence: key 4 (R); key 23 (O); key 17 (B); key 3 (E); key 4 (R); and key 5 (T). The first name of this employee has now been punched in this card and the column indicator is at column 11.

i) Column 11 is to be left blank, so press the space bar (bottom of chart). Nothing will be punched, but the card will move 1 card column and the column indicator will be at column 12.

j) We are now ready to punch the employee's last name. The following keys are pressed in sequence: key 7 (A); key 26 (L); key 26 again (L); key 7 (A); and then key 18 (N).

k) The column indicator is now at column 17. Since columns 17-23 are to be blank, press the space bar 7 times and the card will move to be positioned at column 24.

l) We are now ready to punch the last field to be punched on this card — Social Security Number. Note that on the source document although social security is typed with dashes and spaces, these dashes and spaces are not to appear in the card as we have allotted room in the card for only 9 digits.

m) Since the Social Security Number is a numeric field, press the shift key down with the left hand and then in sequence press the following keys: key 21 (1); key 26 (6); key 25 (5); key 28 (8); key 29 (9); key 26 (6); key 27 (7); key 28 (8); and then key 22 (2).

n) When we have finished punching the Social Security Number, we have punched this card completely. We now press the Release Key (34), which skips the card out of the punch station into the reading station.

Suppose that now we wanted another card exactly like the one we just punched. We could obtain a second card by using the Duplicating feature of the key punch and following this routine.

a) Press the Feed Key to cause another card to feed into the punch station.

b) Now press the Register Key. The card in the read station is positioned to be read; and the card in the punch station is positioned to be punched.

c) Duplicating is done now by holding down the Duplicate Key (32). It is held down for all the columns to be duplicated. Spacing for blank columns is automatic. When we reach column 33, we take our finger off the dupl. key and then press the Release Key (34). The first card punched is at the station to the left of the read station; the second card is at the read station.

d) Both cards are finished. To place them in the stacker, press the Register Key. This moves the first card into the stacker and positions the second card at the reading station. Depressing the Release Key again causes the second card to move through the reading station; depressing the Register Key again causes the second card to enter the stacker.

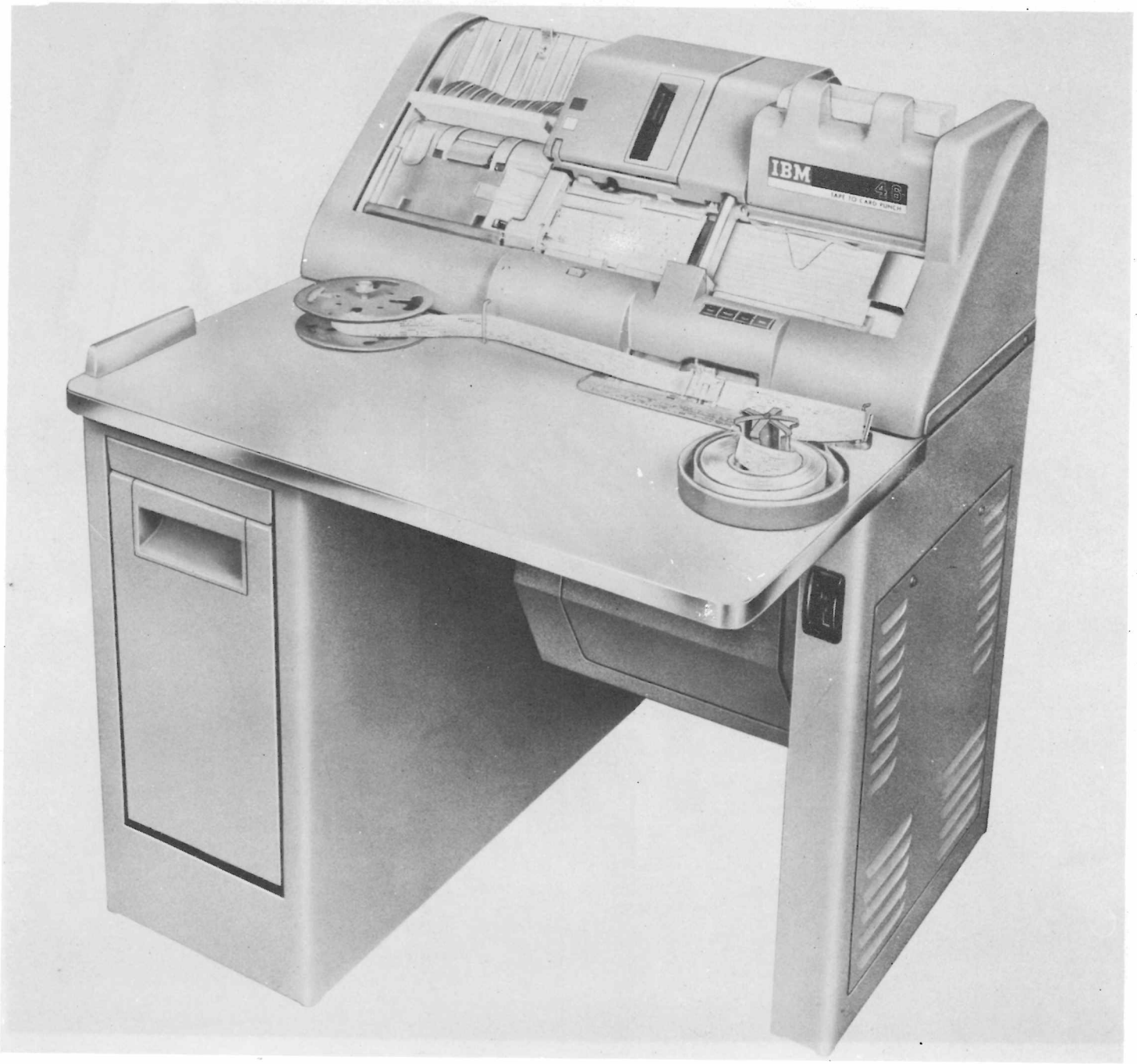
3.3. Three Basic Card Punch Operations

As an I.B.M. Technician, you will not normally be asked to do any key punching other than the three basic operations which will be discussed below:

1. Punching individual fields such as date fields, or placing control punches into cards.
2. Correcting cards which contain errors.
3. Re-punching damaged cards.

Let us examine each of these operations in detail by following the procedure required for each type.

Example 1: Punch a card with a date (month, day & year) in card columns 26-31 and an X punch in col. 56.



IBM 1401
DATA PROCESSING SYSTEM
IBM

1. Turn on the Main Line switch to supply electricity to the machine (Figure 3, item 5).

2. Depress the Release key (Figure 8, key 34). The column indicator (Figure 3, item 8) will turn to column 1 as soon as the machine is warmed up and ready for use.

3. This is a manual operation; therefore, turn the functional switches (Figure 3, item 13) OFF, and press back the Program Control Lever (Figure 3, item 6).

4. Cards are placed in the card hopper (Figure 3, item 10).

5. Press the Feed Key, (Figure 8, key 35) to cause a card to feed down into the Punching Station (Figure 3, item 11); and then press the Register Key (Figure 8, key 37) to position the card at column 1.

6. We are to begin punching in column 26. To move the card to column 26, depress the space bar 25 times. By watching the column indicator, you can tell when column 26 has been reached.

7. Assume that the date to be punched is May 13, 1960. Hold down the shift key (Figure 8, key 30), and then depress key 20 (zero), key 25 (5). We have now punched the month code for May. Still holding the shift key down, depress key 21 (1), key 23 (3), key 26 (6) and key 20 (0). This causes the day (13) and the last two digits of year (60) to be punched.

8. Now space to column 56 by depressing the space bar as many times as is necessary and watching the column indicator until it is on column 56.

9. Press the shift key down again and then press key 33 (the skip key). This will cause a punch to appear in the 11 zone (also called an "X" punch).

10. We have finished punching this card. Press the Release key to pass the card through the punch station; then press the Register Key to position it at the Read Station; then the Release Key again to pass it through the Read Station; then the Register Key again to place the card in the stacker.

11. Read the card to be sure it has been punched correctly.

12. Turn off the main line switch.

13. Refer to Figure 9 for an illustration of what this card would look like when completely punching.

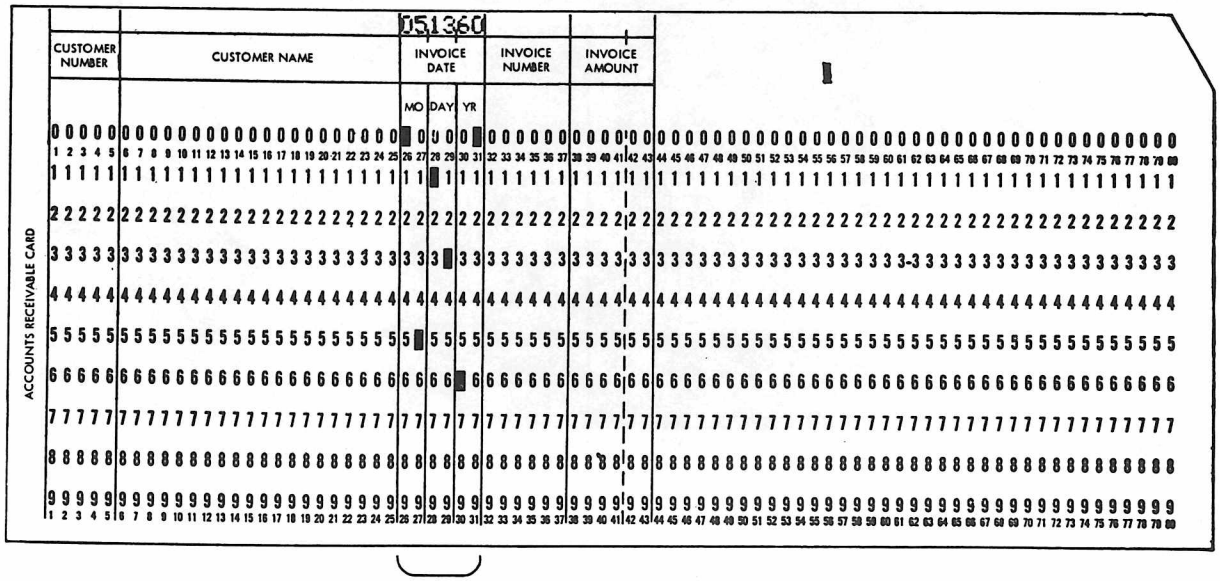
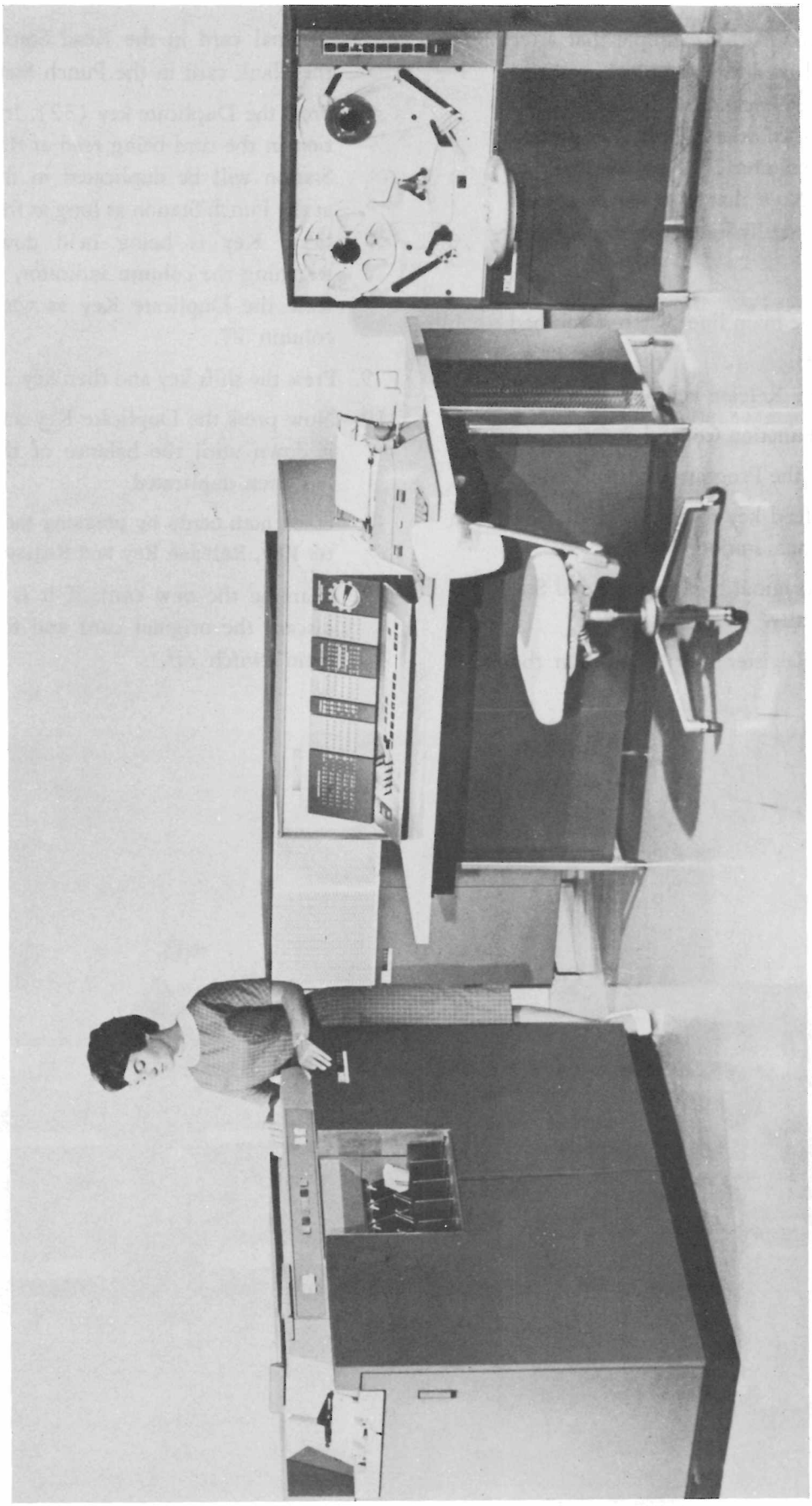
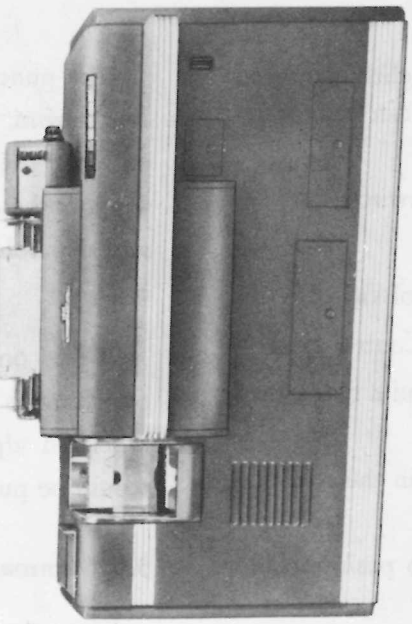


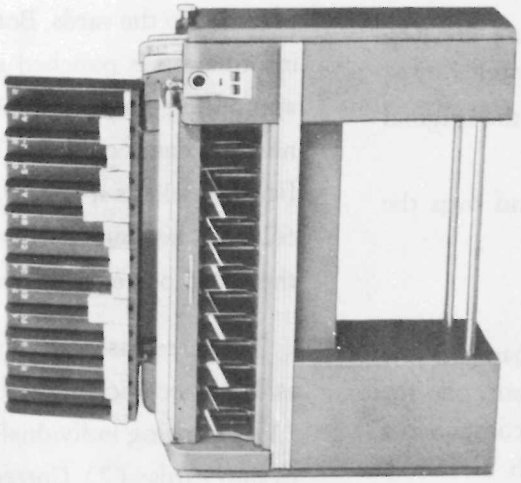
Figure 9.



Example 2: Assume in this example that after punching the card used in Example 1, you discover that you have punched the date as 081360 instead of 051360. In other words, you pressed the wrong key at column 27. Now you have to correct this card. Note that in order to correct this card we will actually have to create another card.

1. Turn on the main line switch if you had shut it off.
2. Depress the Release key.
3. Turn the Function Control Switches off.
4. Turn back the Program Control Lever.
5. Press the feed key to send a blank card to the punch station.
6. Place the original card in the Read Station manually.
7. Press the Register Key to position the original card in the Read Station and the blank card in the Punch Station.
8. Press the Duplicate key (32). Information in the card being read at the Read Station will be duplicated in the card at the Punch Station as long as the Duplicate Key is being held down. By watching the column indicator, you release the Duplicate Key as you reach column 27.
9. Press the shift key and then key 25 (5).
10. Now press the Duplicate Key and hold it down until the balance of the card has been duplicated.
11. Stack both cards by pressing the Register Key, Release Key and Register Key.
12. Examine the new card; if it is correct discard the original card and turn the main switch off.





Example 3: A card has been slightly damaged and it must be re-made before it can be processed by other machines.

1. Turn on the main line switch.
2. Depress the Release key.
3. Turn the Function Control switches off.
4. Turn back the Program Control Lever.
5. Press the Feed Key to send a blank card to the punch station.
6. Place the damaged card in the read station manually.
7. Press the Register key to position both cards.
8. Depress the Duplicate key and hold it down until you have duplicated the entire card.
9. Stack both cards by pressing the Register, Release, and Register Keys.
10. Compare the new card with the original to be sure they match.
11. Discard the original card and turn the main line switch off.

3.4 The Punch Mechanism

Figure 10 illustrates the Punch Mechanism. The Card Punch has twelve such mechanisms, one for each zone in the card. The principal components of the punching mechanism are a punch, die, and a stripper.

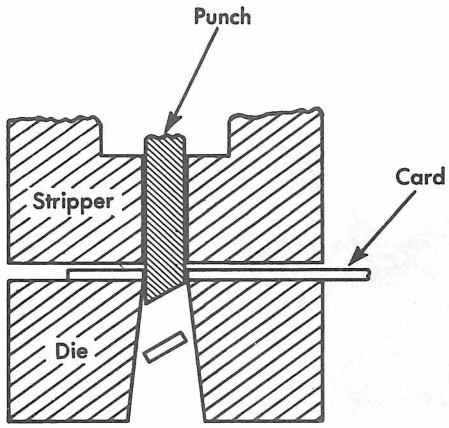


Figure 10. Punch Mechanism

The punch is the actual cutting portion of the mechanism. It is driven down through the card and cuts the rectangular hole. The die is used to support the card. The stripper supports the punch and also holds the card when the punch is brought back up.

When one of the keys which cause numeric punching is depressed, a single hole is created; when an alphabetic key is depressed, two holes would be punched at the same time.

3.5 Summary

The primary use of the I.B.M. Card Punch is to create cards from source documents which contain the data and information which is to be placed into the cards. Both numeric and alphabetic information is punched into cards by pressing the appropriate keys and also the shift key should numeric data be involved. The card is moved from field to field as it is being punched; should certain columns be unused they are left blank by using the space bar to pass over them.

The three basic card punch operations which you as IBM technicians will be concerned with are: (1) Punching individual fields and control punches into cards; (2) Correcting cards which contain errors; (3) Re-punching damaged cards. If you understand how to accomplish these three functions, you have a good understanding of how the Card Punch is used.

GLOSSARY

Alphabetic Status — The normal condition of the IBM Card Punch. Depressing a key on the keyboard when the machine is in alphabetic status will cause the IBM card code for the corresponding alphabetic letter to be punched.

Manual Operation — One where spacing, skipping and duplicating are under the control of the operator. At this time, the program unit and functional switches would not be used.

Numeric Status — Holding down the shift key places the card punch in numeric status. Depressing a key on the keyboard at this time will cause the IBM code for the number on the key depressed to be punched into the card.

Source Document — The particular pieces of paper, forms, reports etc. which contain the data or information which you desire to punch into IBM cards.

"X" Punch — the most common of the control punches. Consists of a single punch in the 11 zone.

EXAMINATION

INSTRUCTIONS — Be sure to study this lesson thoroughly before taking this examination. Read the question carefully, select the correct answer and mark the proper box on the answer sheet. Be sure to answer all questions. Review your answers before submitting them for correction.

1. The IBM Card Punch is used:
   a) To create new cards
   b) To correct errors in cards
   c) To re-punch damaged cards
   d) All of these functions
2. To cause a card to enter the punch station:
   a) Depress the Release Key
   b) Depress the Register Key
   c) Depress the Feed Key
   d) All of these in the sequence indicated above
3. Assume that a card has been punched and the Release Key has been depressed to pass the card through the Punch Station to the Reading Station. To stack this card:
   a) Depress the Register Key; then the Release Key; then the Register Key.
   b) Depress the Register Key; then the Duplicate Key; then the Register Key.
   c) Depress the Release Key; then the Register Key.
   d) None of the above
4. To cause a card to be positioned for punching —
   a) Depress the Feed Key
   b) Depress the Feed Key and then the Register Key
   c) Depress the Release Key
   d) Depress the Register Key
5. The column indicator indicates:
   a) The last column punched
   b) The column about to be punched
   c) The last column duplicated
   d) None of the above is correct
6. To punch an "X" punch in the card
   a) Depress key 14
   b) Depress the shift key and then key 14
   c) Depress the shift key and then key 33
   d) Depress the shift key and then key 36

7.10 Assume that a card has been damaged and is to be re-punched.

Study the following list of operations and in the boxes for answers 7-10 indicate the step numbers to be used in the sequence they are to be used. For example, if step is the first step to be used, mark answer 7 as a C, if step is the next step to be used mark answer 8 as a B etc.

A Remove the cards from the stacker. After checking the new card, discard the original damaged card.

B Press the Feed Key; place the original card manually in the Read Station and then depress the Register Key.

C Depress the Register Key, then the Release Key, then the Register Key.

D Hold the Duplicate Key down until all 80 columns have been duplicated.

I.B.M. DATA PROCESSING AND COMPUTER PROGRAMMING

LESSON #4

TABLE OF CONTENTS

4.1) Function of the I.B.M. Interpreter

4.2) Operating Characteristics of the Interpreter

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4.5) How IBM Machines Read Cards

4.6) Use of the Control Panel

4.7) The I.B.M. Type 552 Interpreter Control Panel

Problems and Exercises

Glossary

Examination

Supplement – I.B.M 548 Interpreter

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ELECTRONIC COMPUTER PROGRAMMING INSTITUTE

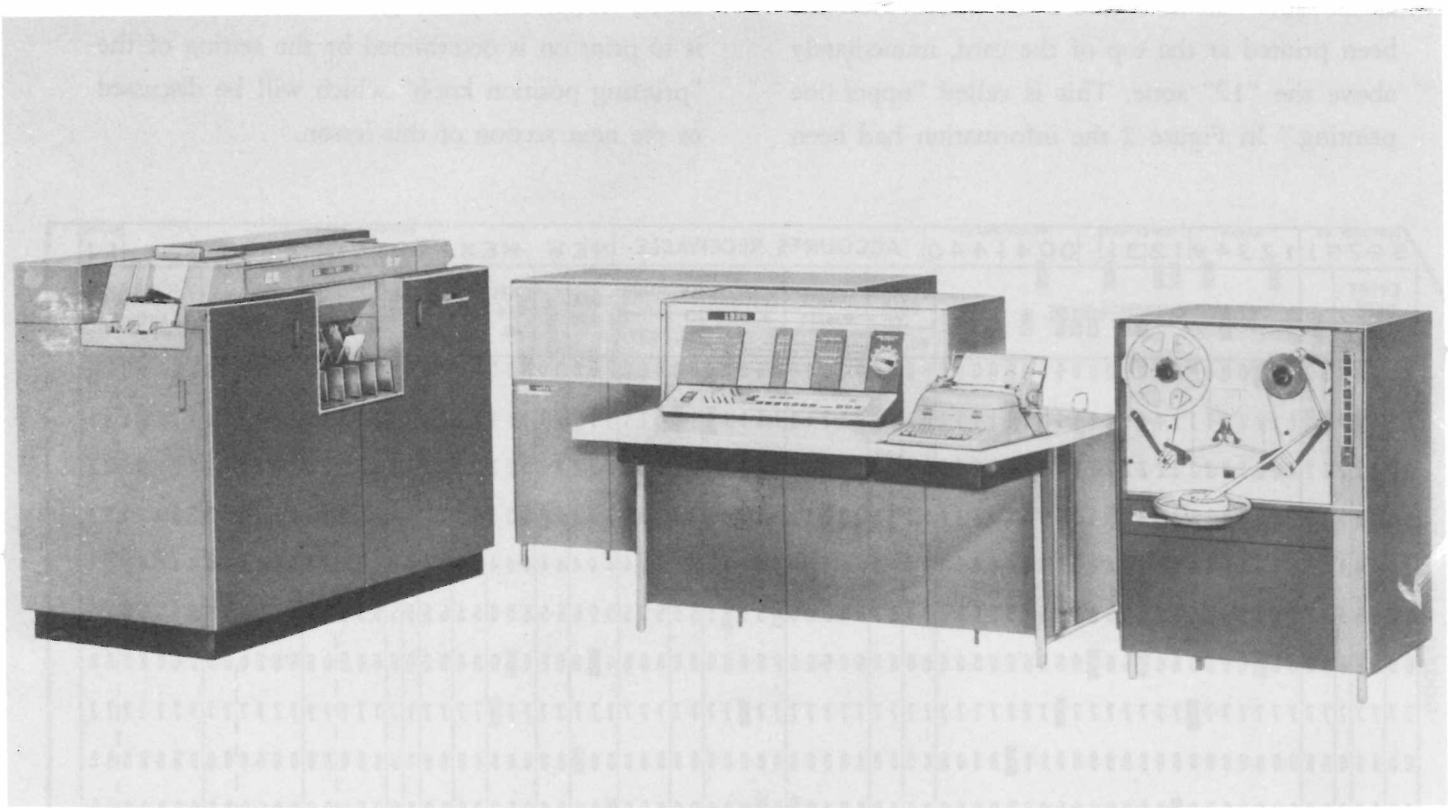
PREFACE

We have now progressed to the point where we are able to create I.B.M. cards (using the I.B.M. Card Punch) and then by inspection of the holes in the card, we can read the information that has been punched in the card.

In this lesson, we are going to study the I.B.M. Interpreter. The function of this machine is to print on the face of the card (in English) the information which has been punched in the card. This is the first machine you will study that has a "Control Panel." The control panel is the tool provided to you to enable you to give instructions to these machines — to tell the machines exactly what it is they are to do for you.

As we progress from machine to machine there will be new terms for you to learn. Many of these terms are the same for many different machines. Soon they will be as familiar to you as everyday language.

Let us turn now to the study of the next machine, the I.B.M. Interpreter.



THE I.B.M. INTERPRETER

4.1 Function of the I.B.M. Interpreter

We learned how to read IBM cards in lesson 2. It is not too difficult to learn the IBM codes for the various numbers and letters and with practice on the job, you become accustomed to reading cards by just glancing at them. However, there are many situations where people who are not as familiar with I.B.M. equipment as you are will be required to work with and use IBM cards. To enable them to read cards easily, these cards are interpreted by the IBM Interpreter. This only means that we have a machine that can read the holes punched into the card and translate what it reads into English.

Figure 1 and 2 are illustrations of interpreted cards. Note that in Figure 1 the information has been printed at the top of the card, immediately above the "12" zone. This is called "upper-line printing." In Figure 2 the information had been printed between the "11" and "12" zones. This is called "lower-line printing." The line the machine is to print on is determined by the setting of the "printing position knob" which will be discussed in the next section of this lesson.

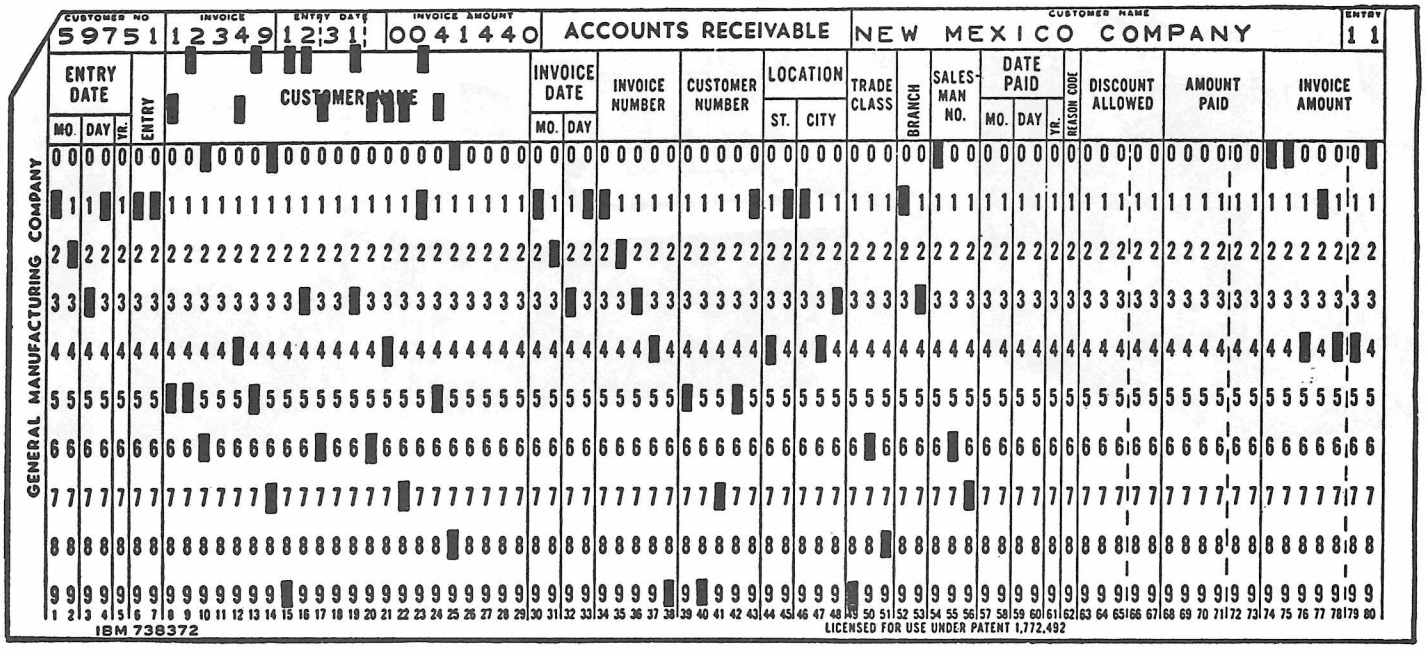


Figure 1. Example of "Upper-line Printing."

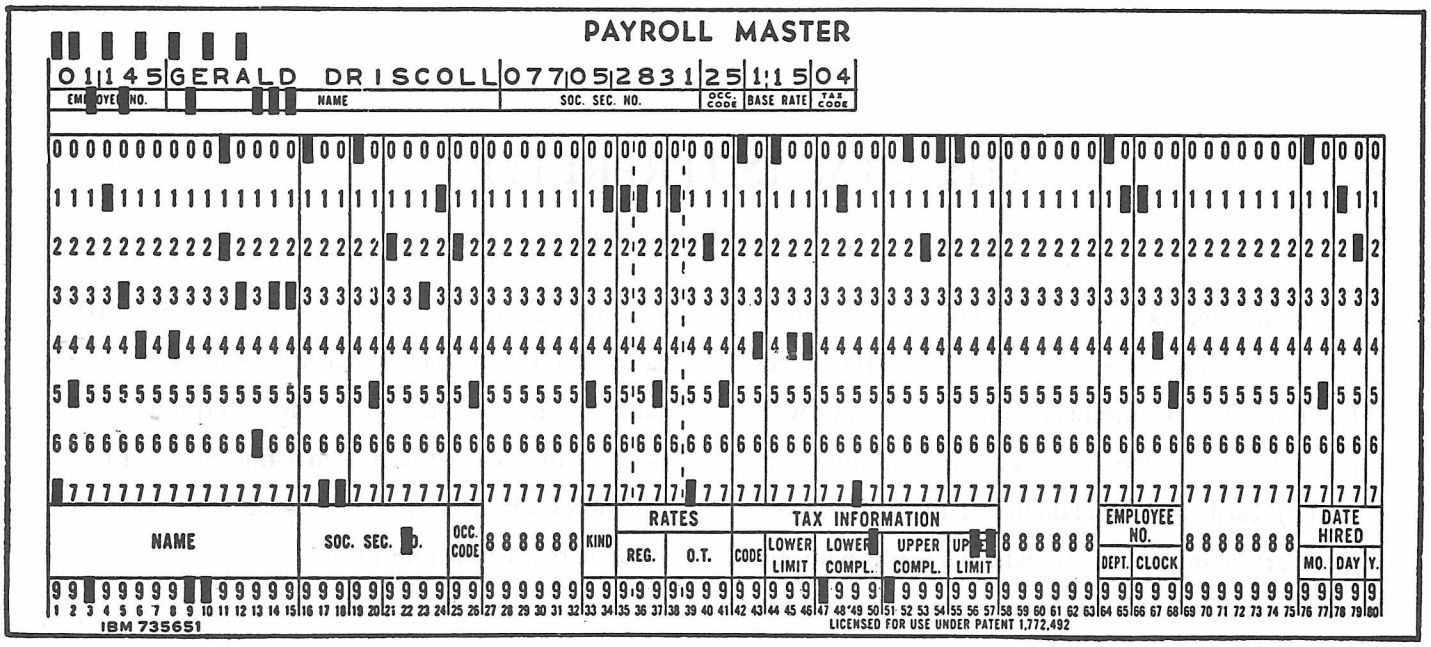


Figure 2. Example of "Lower-line Printing."

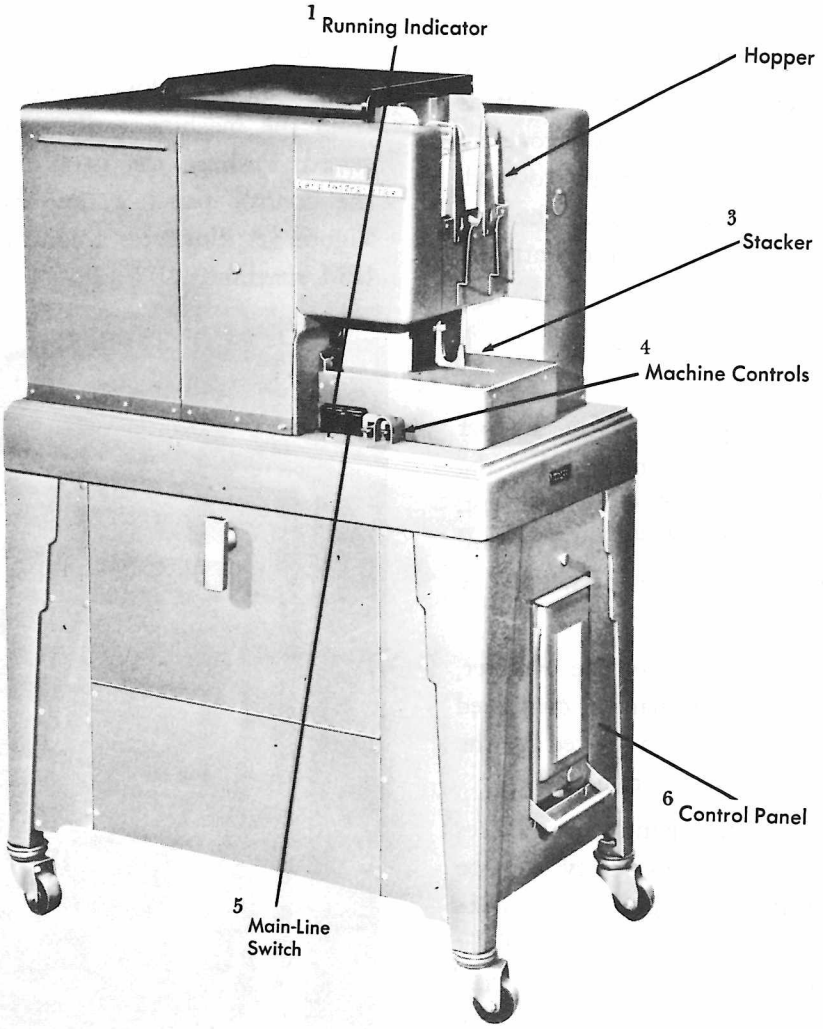


Figure 3. The I.B.M. Type 552 Interpreter

4.2 Operating Characteristics of the Interpreter

The machine illustrated in Figure 3 is the I.B.M. type 552 Interpreter. International Business Machines Corp. (manufacturers of this equipment) make many different machines. They are all given numbers, such as the type 024 Card Punch, Type 552 Interpreter as well as names.

The Interpreter is probably the simplest-to-operate machine I.B.M. makes. Let us look at some of the operating features.

5. *Main Line Switch*—This switch is located in the front of the machine. It must be on for all machine operations.

4. *Machine Controls*—There is a Start and a Stop key. The Start key is the one to the left as you face the front of the machine and is uncovered. The Stop key, on the right, is partially covered. The cover permits you when operating the machine to tell the difference between the Start and Stop keys by feeling for the cover.

1. *Running Indicator*—When the machine is On, a small green bulb glows.

2. *Hopper*—Cards are placed in the hopper "Face Up", "12 edge" in. This means that the 12 edge of the card will enter the machine first, and that the face of the cards will be up. The card at the bottom of the pack will be the first to be printed.

3. *Stacker*—Cards are fed from the Hopper, are printed by the printing mechanism contained within the machine and are then placed in the stacker from which they can be removed.

6. *Control Panel*—Control panels are devices used on many I.B.M. machines. They can be described as the "brains" of the machine since they are used to direct the machine and tell it what to do. Of course, you as the I.B.M. technician will be responsible for the preparation of the control panel. What each I.B.M. machine will do depends on what you tell it to do.

The term used to describe the preparation of a control panel for use is called "control panel wiring." We are going to discuss the basic principles which apply to control panel wiring in later parts of this lesson.

Note that there is a handle directly below the control panel. By raising this handle, the control panel will tilt backward so that it can be removed from the machine easily and another panel inserted. Pushing the handle down again pushes the control panel in and positions it for use. Figure 3A illustrates a control panel for another IBM machine.

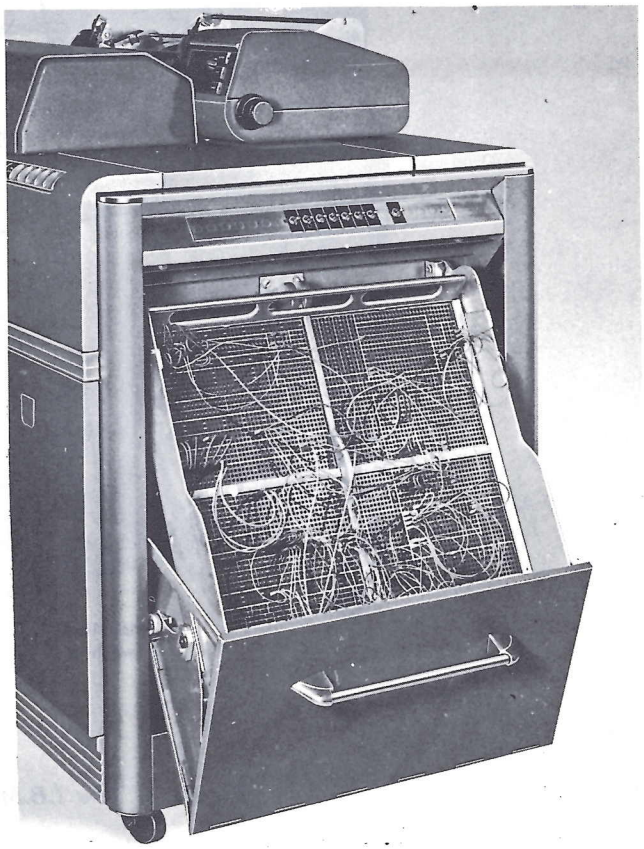


Figure 3A.

4.3 Machine Operation

Assume that you have a deck of cards which are to be interpreted. First, you turn the Main Line Switch on; then place the cards in the Hopper, Face Up, 12 edge in; you then select the proper control panel (the one which will print the fields you want printed in those positions of the card you have selected). You raise the handle below the control panel, remove the panel presently in the machine, insert your panel and lower the handle. Now remember, you can print on either of two lines. Figure 4 illustrates the positioning knob which is at the back of the machine. If you want to print on the top line, turn the knob to the Upper Position; to print on the bottom line, turn the knob to the lower position. Now, press the Start Key and the machine will begin to print. After the last card has been printed, it will automatically stop and place the last card in the stacker.

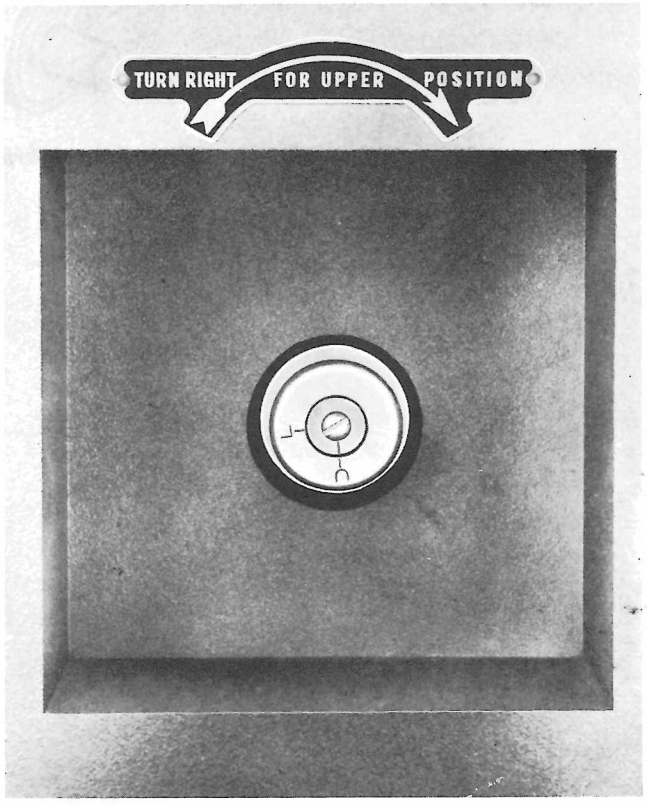


Figure 4. The Printing Position Knob

4.4 Introduction to Control Panel Wiring

The control panel is the means whereby you, as the I.B.M. Technician, are able to give direction and instructions to I.B.M. equipment. It follows, therefore, that a thorough understanding of the basic principles which apply to the preparation of control panels (called control panel wiring) is necessary in order for you to build a successful career in I.B.M. Data Processing.

The fundamental characteristic of all I.B.M. machines is their ability to read information which is present in I.B.M. cards and then be able to do something with this information. The interpreter, for example, can read the information which is present in an I.B.M. card; it can then cause this information to print on the face of the card. Let us examine first the means whereby I.B.M. machine can "read" information from cards. We will then examine how by means of a "control panel" this information is used by the machine.

4.5 How IBM Machines Read Cards

We are able to read because we recognize numbers and alphabetic characters and they are meaningful to us. We read because light energy is reflected from the page to our eyes and then sent to the brain which can recognize the pattern of the various numbers and letters. The two elements present in "reading" are (1) light energy to transmit the characters to the brain, and (2) the ability of the brain to recognize the characters transmitted to it. Let us see how I.B.M. machines read.

Instead of light energy, I.B.M. machines will use electrical energy. As an IBM card passes through the machine, it passes over an electric contact roller and under a brush. Figure 5 illustrates the contact roller, card and brush.

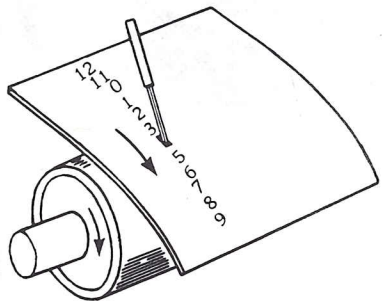


Figure 5. A brush reading a card column

As the card passes through the machine, the card acts as an insulator between the contact roller and the brush so that it is not possible for electrical current to flow from the roller to the brush. However, if there is a punch in the column being read, the brush will drop down through the hole in the card and touch the contact roller. This will permit electrical energy to flow through the brush to the "brain" of the machine for a short moment. Electrical energy will flow from the contact roller through the brush until contact between the roller and the brush is broken by the balance of the unpunched portion of the card as it continues to move. Figure 6 illustrates how a "1 punch" in a card is read.

We now have accomplished the first requirement in a reading operation: we have a means of directing energy (in this case electrical energy) to a part of the machine we can refer to as the machine's brain (the control panel.)

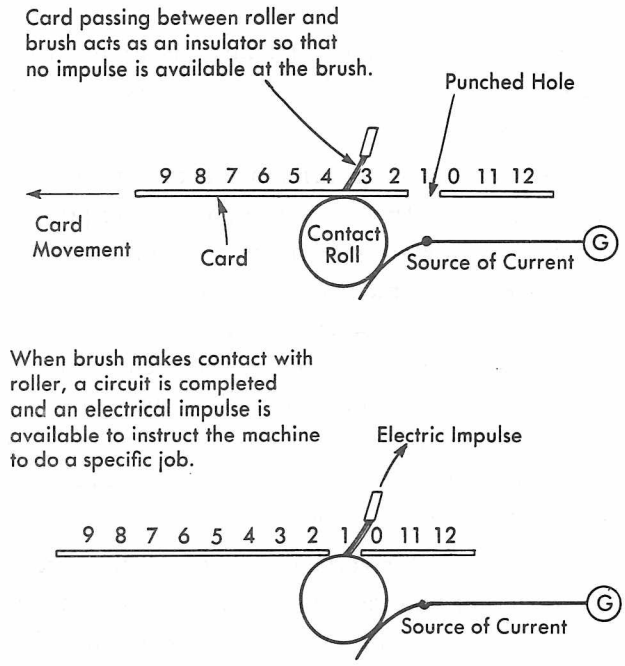
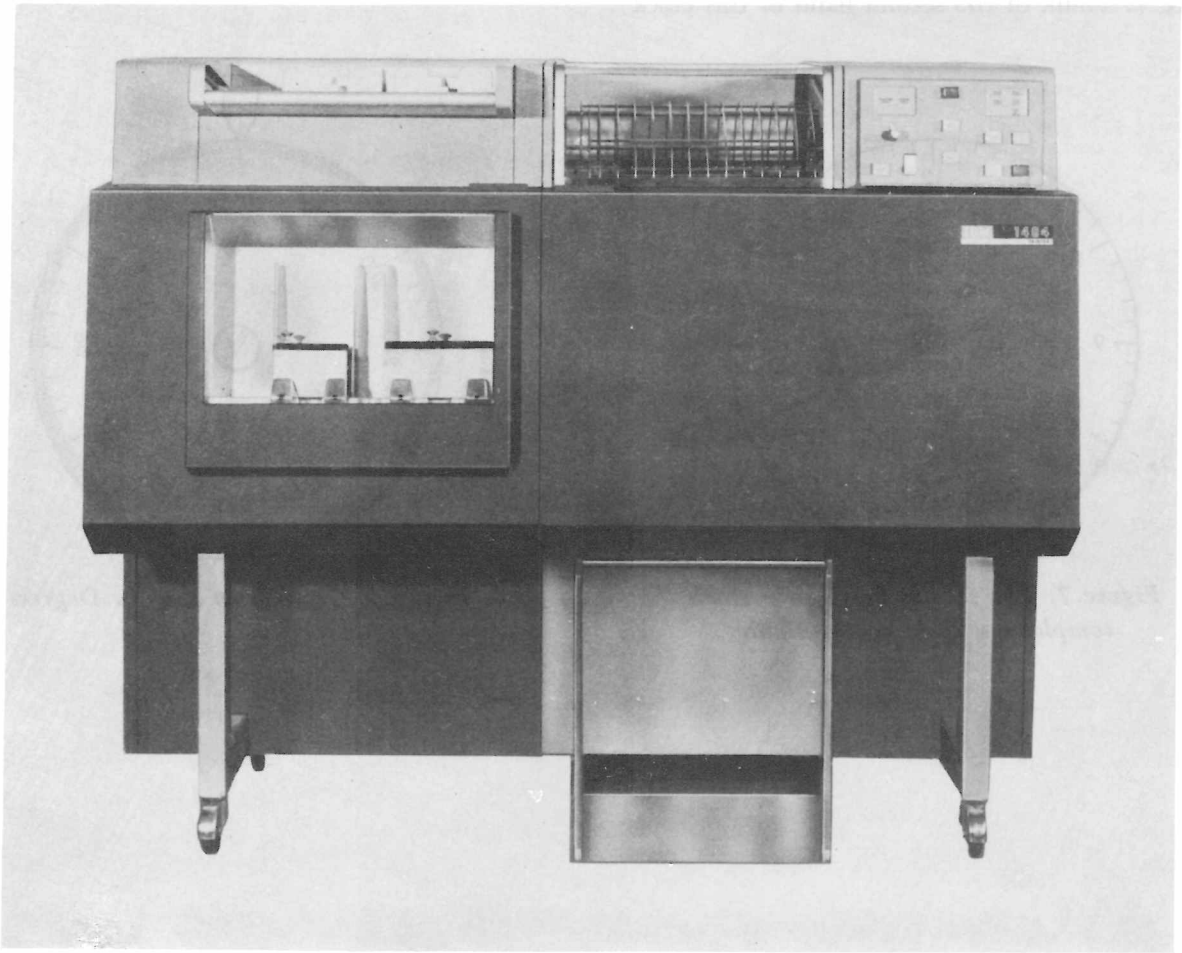


Figure 6. A brush reading the number 1



The second part of "reading" is to recognize characters. How do I.B.M. machines recognize characters.

As you know, the difference between one digit and another in IBM code is the punching position in the card. The same holds true for alphabetic and special characters; they each have unique (different) combinations of punches in various positions in the card. These different positions in the card are translated into "time" since the brush reads different positions of the card at different times. Thus, "timing" is all-important in character recognition.

The I.B.M. Interpreter operates at the rate of 60 cards per minute. This means that this machine can feed and print one card each second. This period of time is called a "cycle". A cycle therefore, is the amount of time a machine requires to complete a given function.

A cycle can be thought of as a circle. Refer to Figure 7. Think of the second hand of this clock face as a pointer. In one revolution it has completed a cycle. Now, let us change the face of this clock to an IBM Cycle-Timing-Indicator calibrated in terms of the various punching positions of a card, Figure 8, or in terms of degrees (360 degrees in a complete circle) such as in Figure 9.

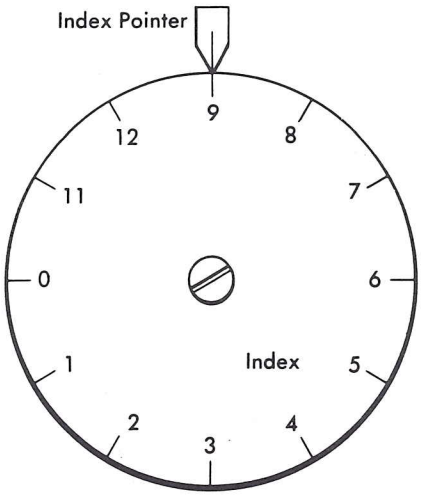


Figure 8. Cycle-Time-Indicating Dial

Figure 7. The second hand on a clock completes a cycle every minute.

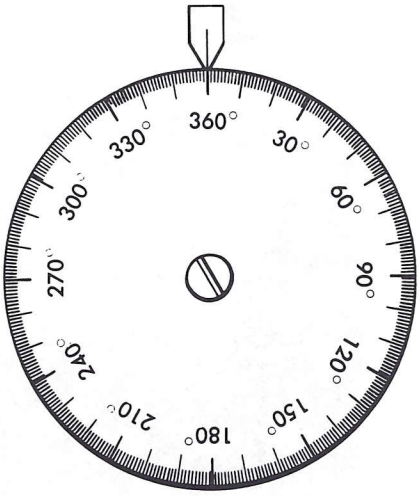


Figure 9. Cycle-Time Dial in Degrees

Let us examine Figure 8. As a card is feeding in the Interpreter, this Timing Index is turning. It will turn once, clockwise, for every card processed. We know that in the Interpreter the card feeds in 12 edge first. Therefore, the first punching position which can be read is the 12 zone, then the 11 zone, then 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. In some I.B.M. machines cards feed in 9 edge first. The result would be exactly the same except that the index would turn counterclockwise.

Looking at this very generally for a moment, we can say that if the brush makes contact with the roller while the timing index is between 1 and 2, the Interpreter will recognize this character as a 1 since the electrical energy was received at this "time" in the cycle.

Actually, the divisions 12-9 are not accurate enough for timing purposes. The timing index is actually divided into degrees as in Figure 9.

Let us look at Figure 9 in combination with Figure 10.

If, as the card is being fed through the machine, electrical energy is directed to the control panel between 170-160 degrees, then this "Impulse" will be recognized as the digit 1; if the impulse is received between 30-20 degrees, it will be recognized as the digit 8, and so on.

We can now say that the different digits and alphabetic characters are recognized by the time in the machine cycle that electrical energy (impulses) are received by the control panel.

4.6 Use of The Control Panel

We have seen how cards are read. How then is the control panel used. Figure 11 illustrates how information is read from a card and is transmitted to the control panel.

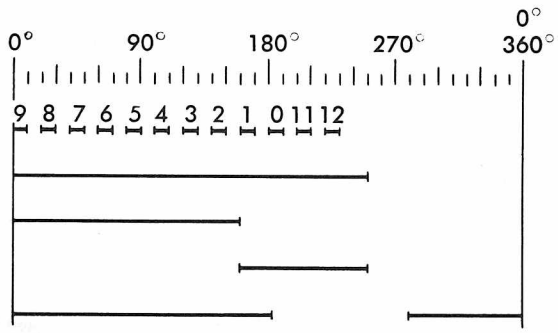


Figure 10. Timing Chart in Degrees

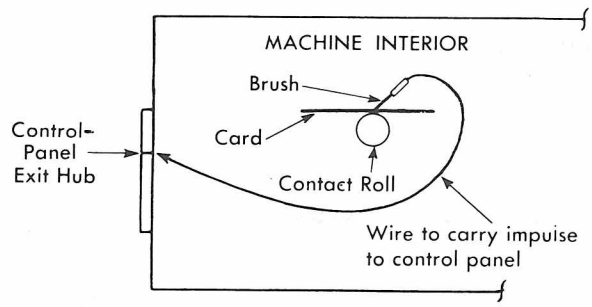


Figure 11. Impulse read from card goes to Control Panel

The control panel operates very much like a switchboard. An incoming call is answered by the operator as she plugs a cord into a hub on the board which is receiving the call. She then plugs a cord into another hub which is connected to the telephone she wishes to ring. What has happened is that the operator has completed an electrical circuit at the switchboard.

The control panel works exactly the same way. You complete electrical circuits by the external wires you connect. When the control panel is inserted in the machine the "jacks" on the back of the panel touch each of the machines metal contacts. When the external wire is inserted, the electrical circuit is completed. See Figures 12 and 12A.

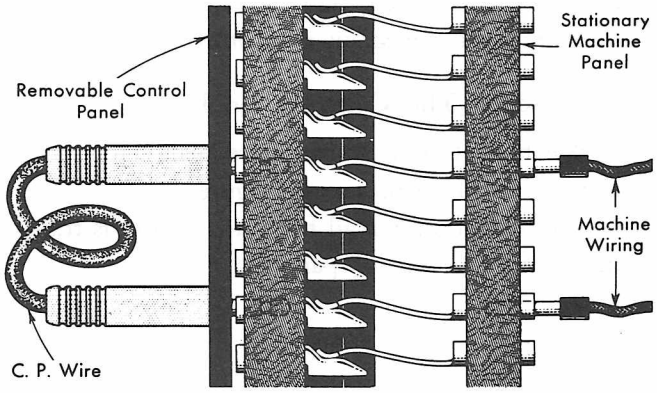


Figure 12. External Wire completes Electrical Circuit

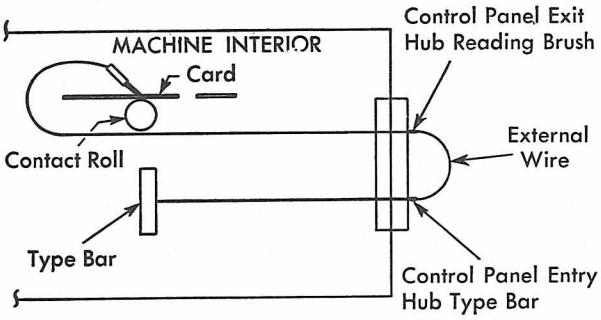
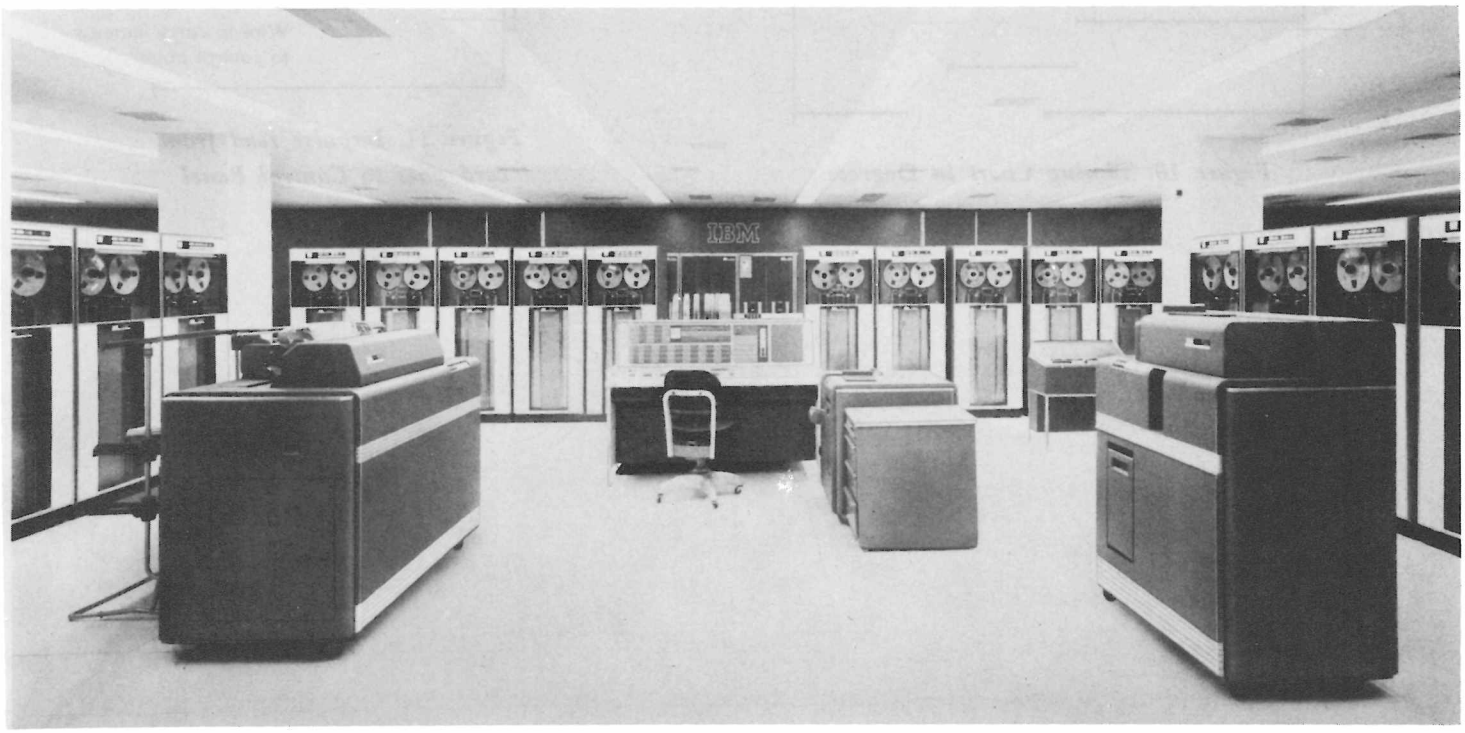
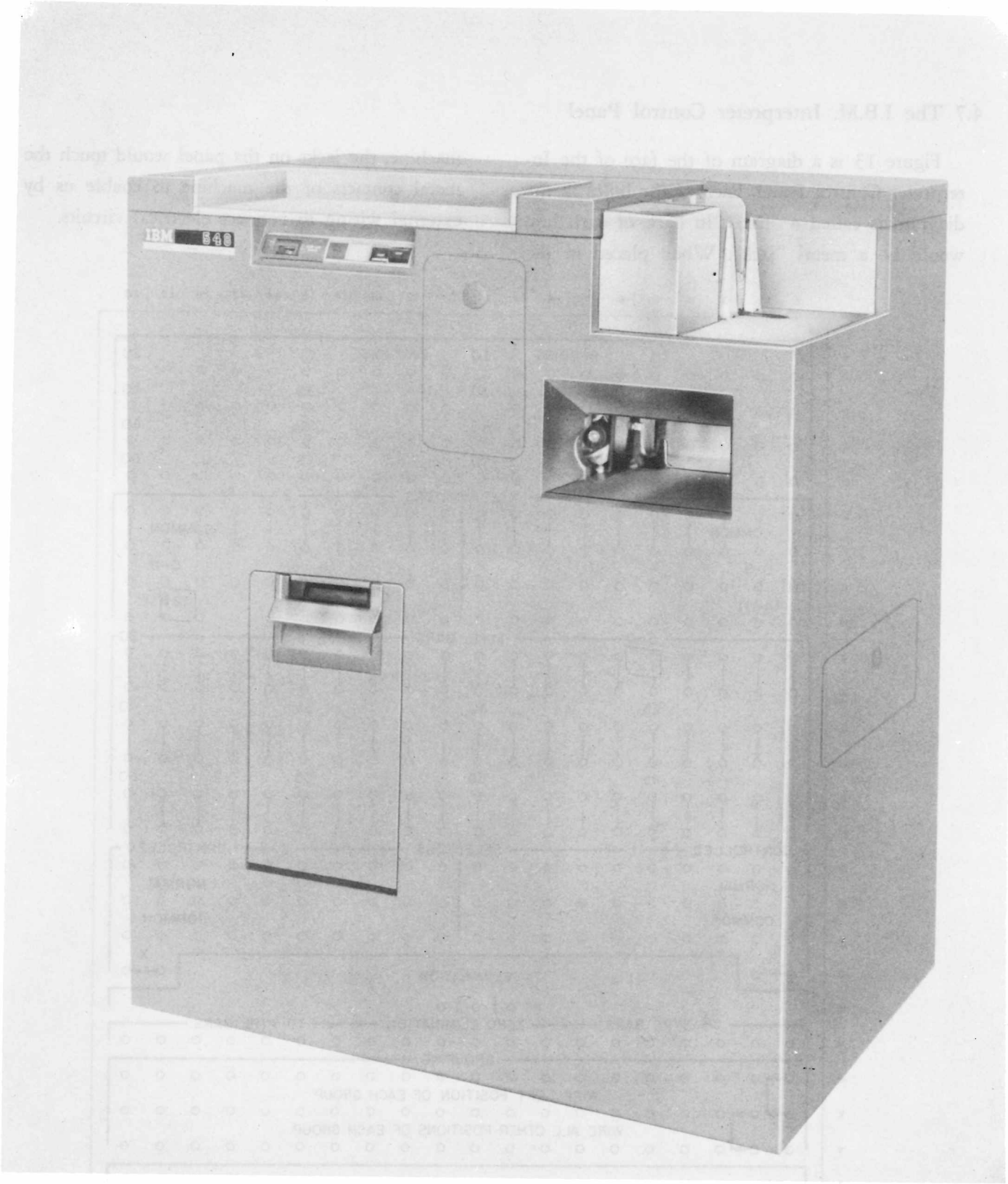


Figure 12A. Wiring Schematic





Let us assume that an electrical impulse is coming through the top internal wire. The impulse goes through the upper contact to the "jack" touching it. It is then available from the upper part of the external wire that was placed in the panel. It flows through this wire into the bottom jack; then through the bottom contact to the lower internal wire which is connected back into the machine to cause printing or some other operation.

4.7 The I.B.M. Interpreter Control Panel

Figure 13 is a diagram of the face of the Interpreter Control Panel. Each of the holes in the diagram is called a "hub". In back of each hub would be a metal "jack". When placed in the machine, the jacks on the panel would touch the metal contacts of the machine to enable us by external wiring to connect electrical circuits.

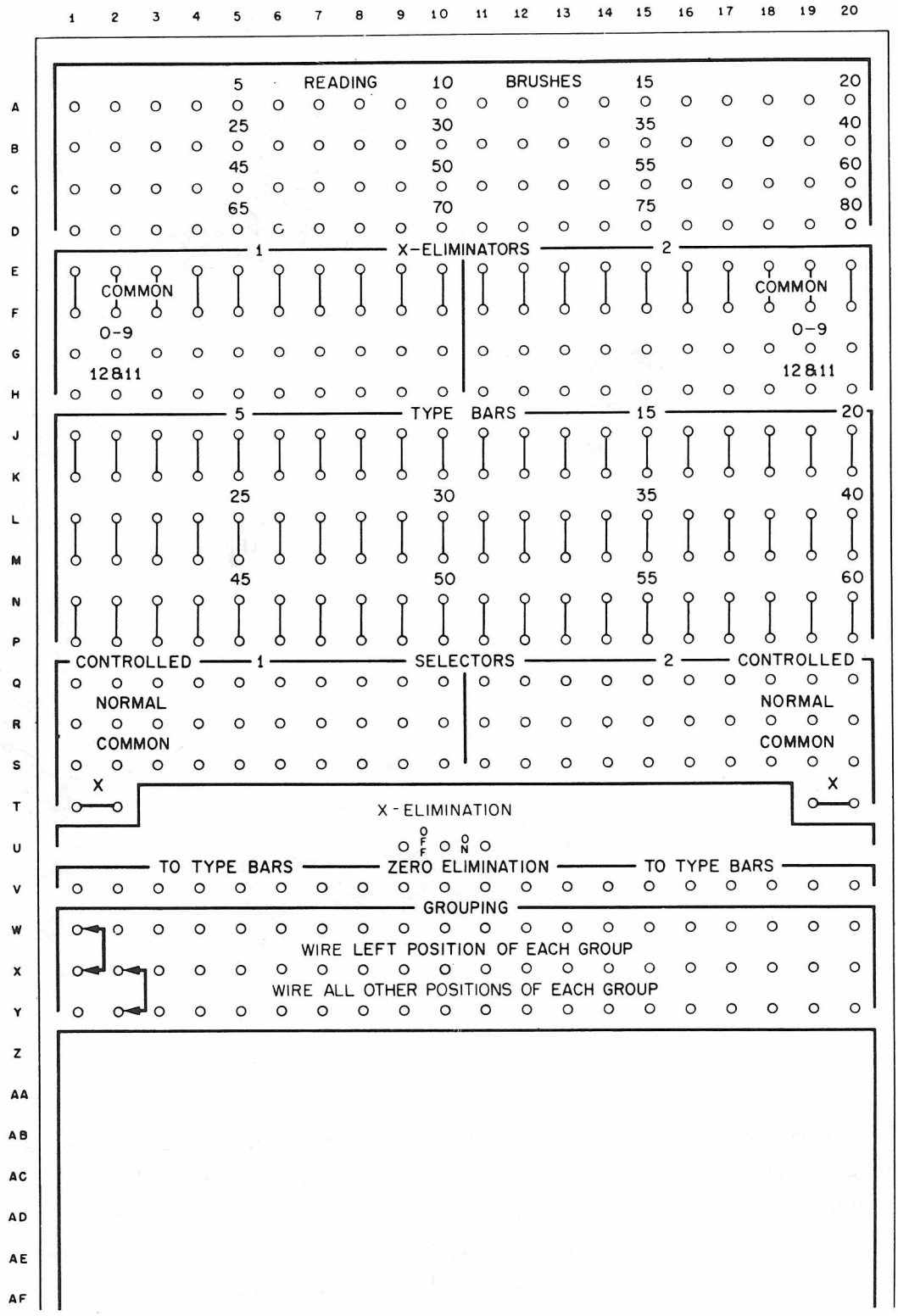


Figure 13. The I.B.M. 552 Interpreter Control Panel

Hubs on the panel are normally arranged in groups and labelled. These groupings will represent functions which the machine can perform. For example, the first four rows of hubs are labelled *Reading Brushes.* We know that the IBM card has 80 columns. Inside the Interpreter there are 80 brushes which will read each column of the card as it feeds through. The Reading Brush hubs are numbered for easy reference.

Do not let the sight of so many hubs confuse you. As you will see the various hubs within a group function the same way; once you learn the function of the group you will know how to use each hub in the group.

Hubs on I.B.M. Control Panels are generally divided into two classes: Entry hubs and Exit hubs. An Entry hub is one which will accept an impulse to cause the machine to do something; an Exit hub gives out (emits) an impulse and is wired to an entry hub. For example, the 80 reading brush hubs are all exit hubs as they emit the same impulses which are sent to them by the reading brushes which are reading the card. Wiring on IBM control panels is from exit to entry hubs.

Any column in the card can be printed anywhere on either the upper or lower printing lines. A maximum of 60 columns can be printed on either line. If more columns are required to be printed, they will have to be placed on a second line.

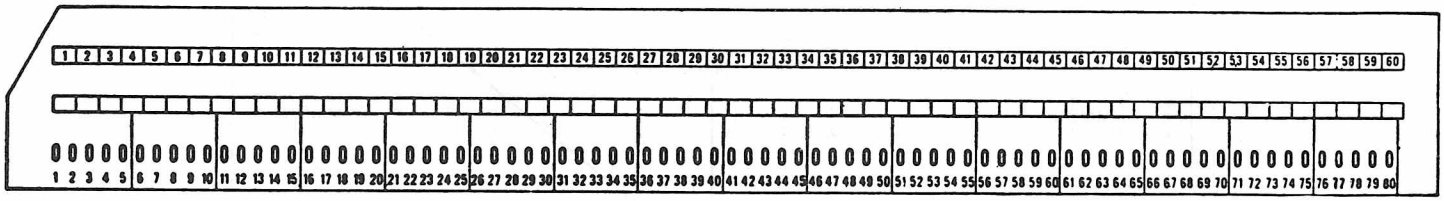


Figure 14. The 60 print positions.

Each print position is assigned a number. Figure 14 illustrates the 60 Interpreter Print Positions. For each print position there is a typebar inside the interpreter. A typical typebar schematic is illustrated in Figure 15. Note that all the digits and alphabetic characters are represented on the typebar. Each of the typebars is numbered to correspond to its printing position. Note in Figure 13 the 60 type bar entry hubs (rows J-P).

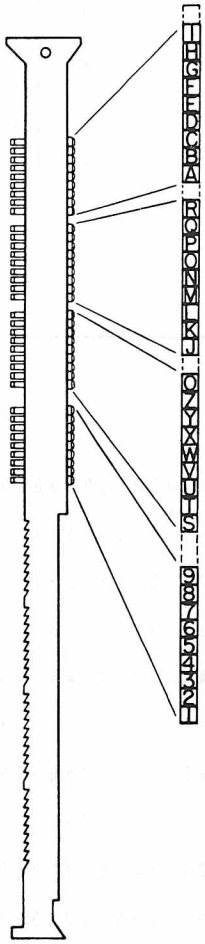


Figure 15. A typical Interpreter Type Bar

When you wire from a reading brush to a type bar, the character contained in that card column will be read by the reading brush and the impulse generated will cause this character to print from the typebar selected. The type bar selected depends on where on the face of the card you want the information printed. Typebar 1 is on the left end of the card; typebar 60 on the right end.

Let us try a very simple wiring problem and diagram it. Assume that we want to print column 20 in typebar 10. The control panel wiring required for this problem is contained in Figure 16. Only those portions of the panel required for this problem are used. Note that the arrow goes from exit to entry hub. Figure 17 illustrates a card interpreted for this problem.

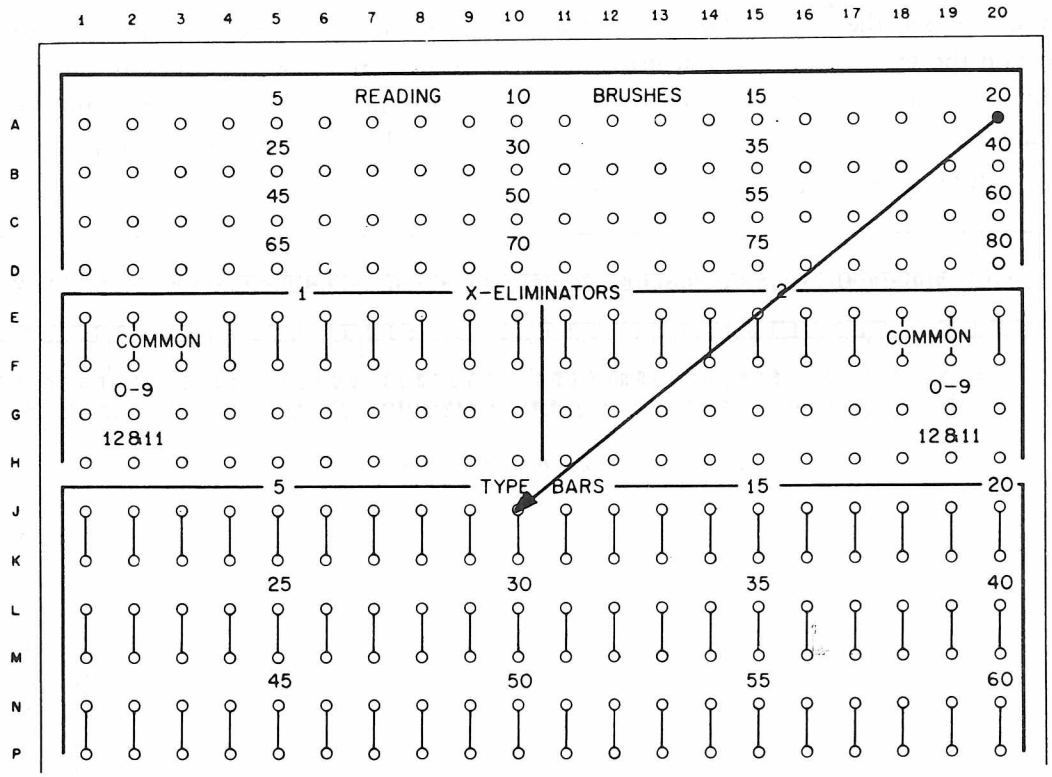


Figure 16.

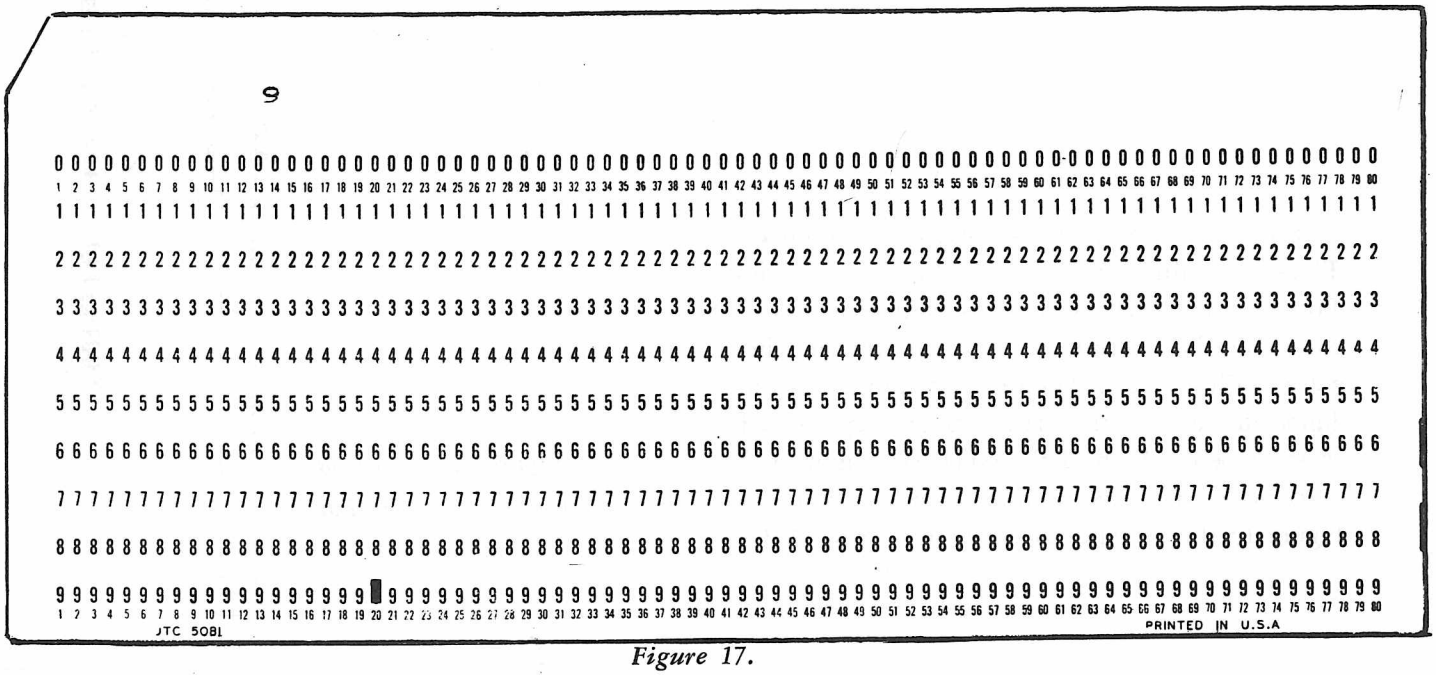


Figure 17.

Let's try another problem. Print c.c. 1-4 (card columns 1 to 4) in t.b. 2-5 (type bars 2 to 5). Figure 18 illustrates this problem and Figure 19 the card as interpreted.

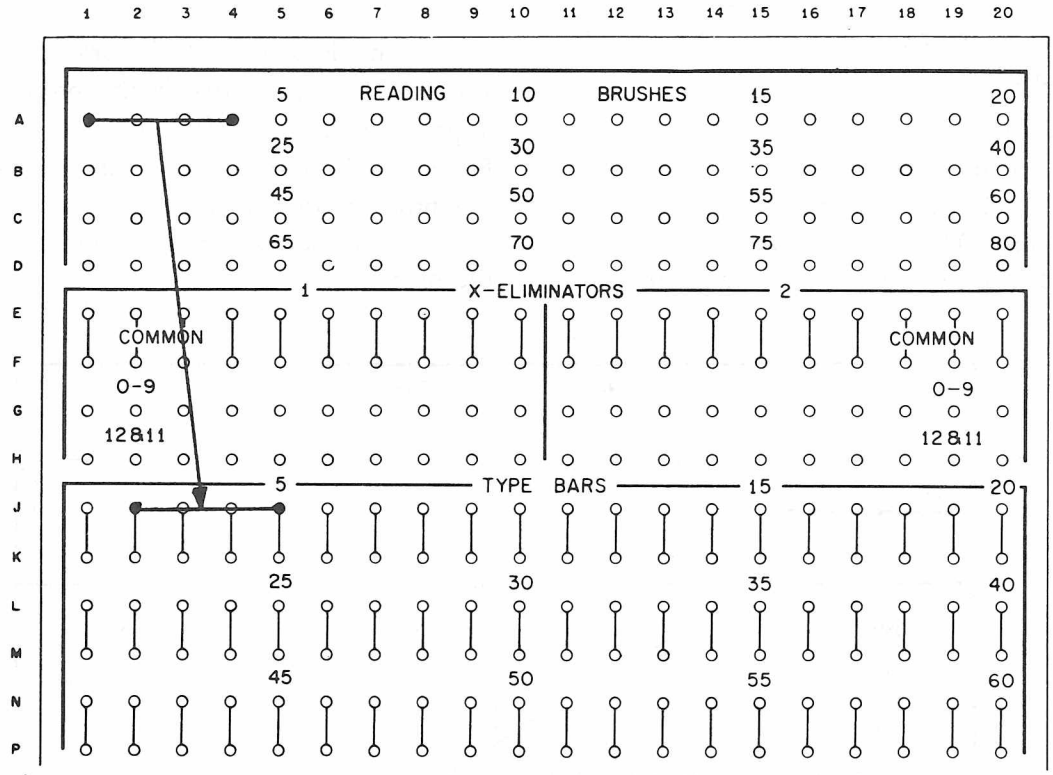


Figure 18.

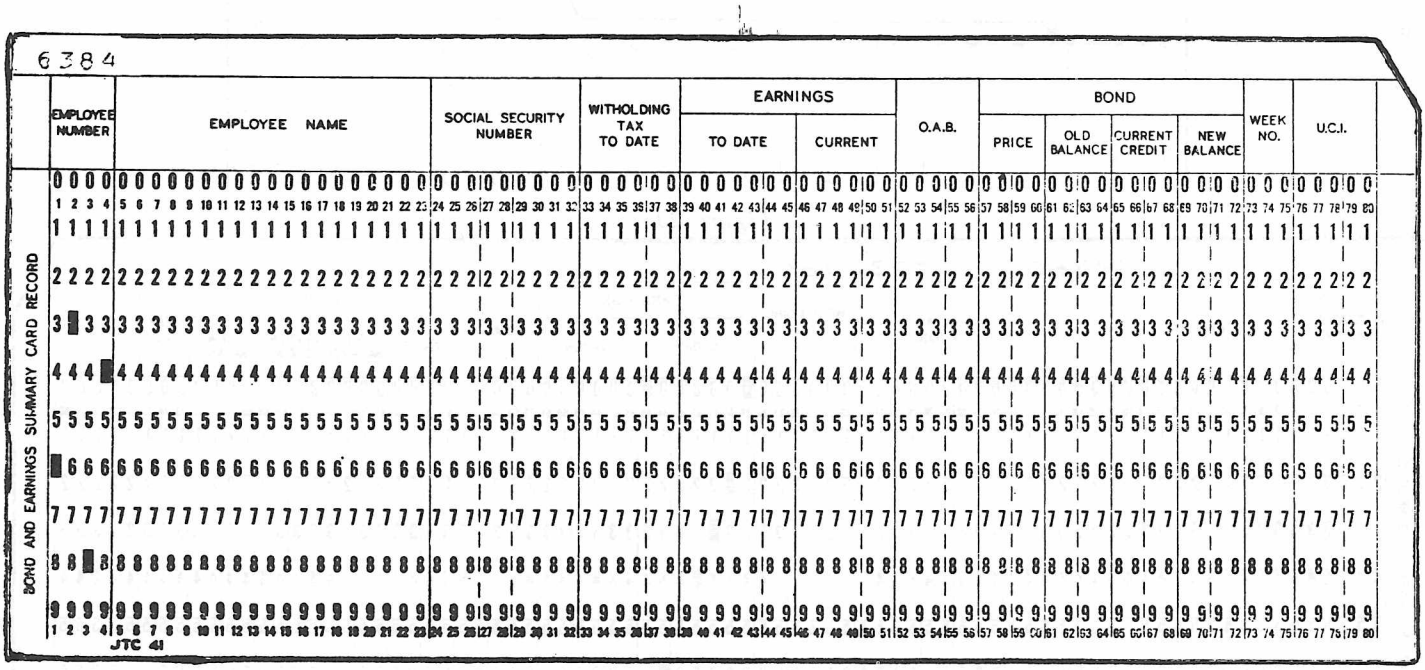


Figure 19.

Note the diagramming technique used to wire entire fields. The hubs corresponding to the high-order and low-order positions of the field are filled in and they are then connected. A single arrow from the exit field to the entry field is all that is required.

Note that there is a single hub for each reading brush, but that there are two hubs for each type bar. Also the hubs for each type bar are connected on the diagram. Hubs such as these are called "Common Hubs." This means that they are connected to one another so that an impulse wired to one of them is available from the other. The next problem will illustrate the use of common hubs.

Problem: Print c.c. 39-45 from t.b. 10-16 and also t.b. 21-27. Note that in this problem we are to print the same field from two sets of type bars. Figure 20 illustrates the diagrammed solution to this problem and Figure 21 the card used. Note the use of hooks to indicate a field continued on the next line.

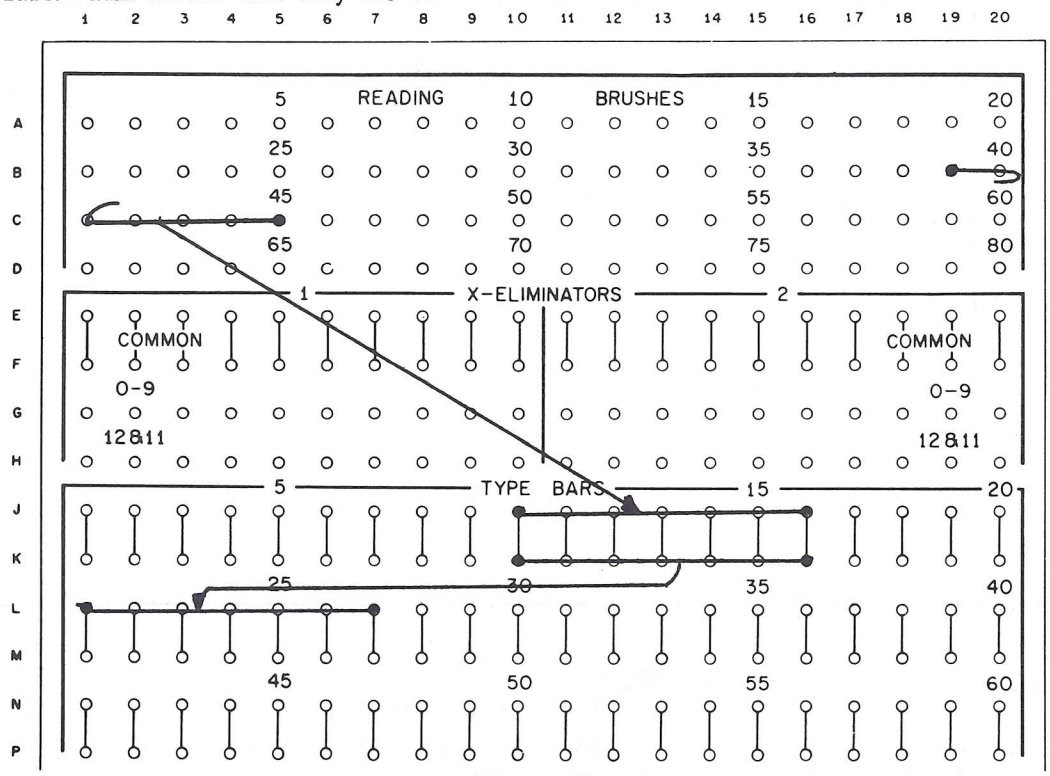


Figure 20.

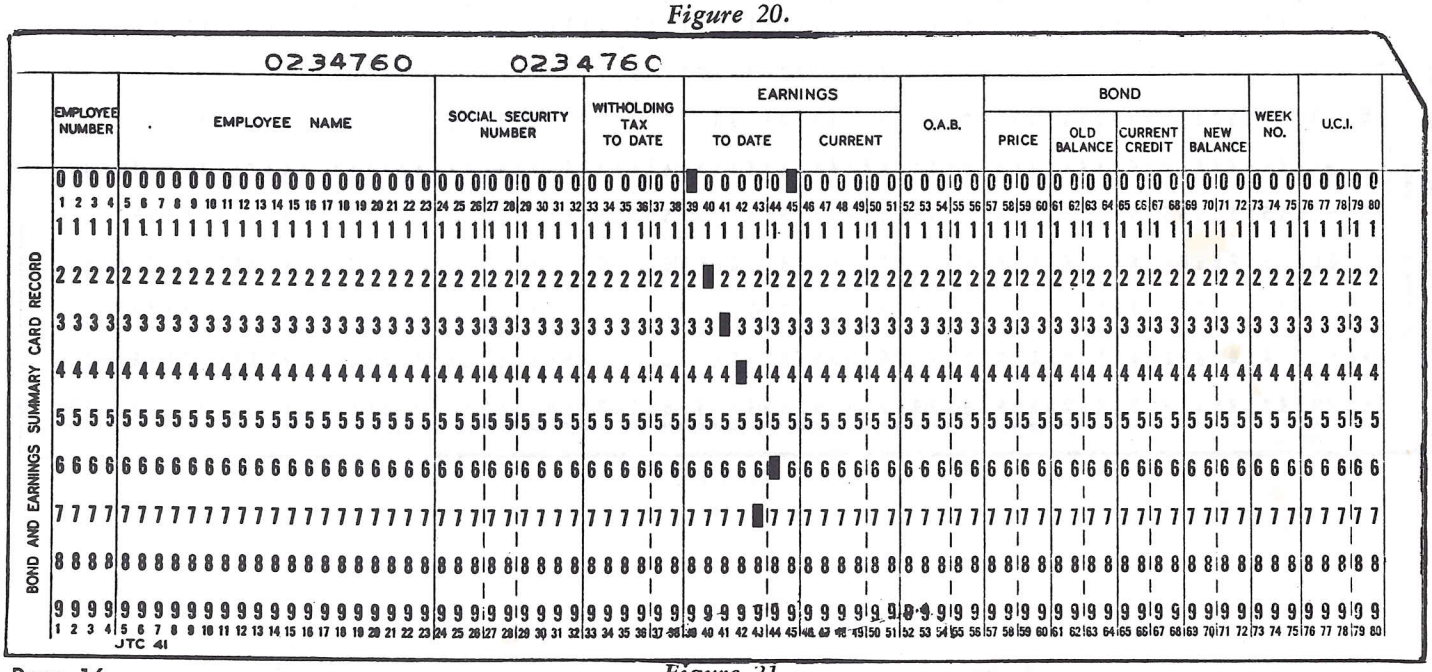


Figure 21

Problem: Print c.c. 1-4 from t.b. 3-6; c.c. 5-23 from t.b. 25-43; and c.c. 24-32 from t.b. 45-53.

Figures 22 and 23 illustrate the control panel diagram and card used.

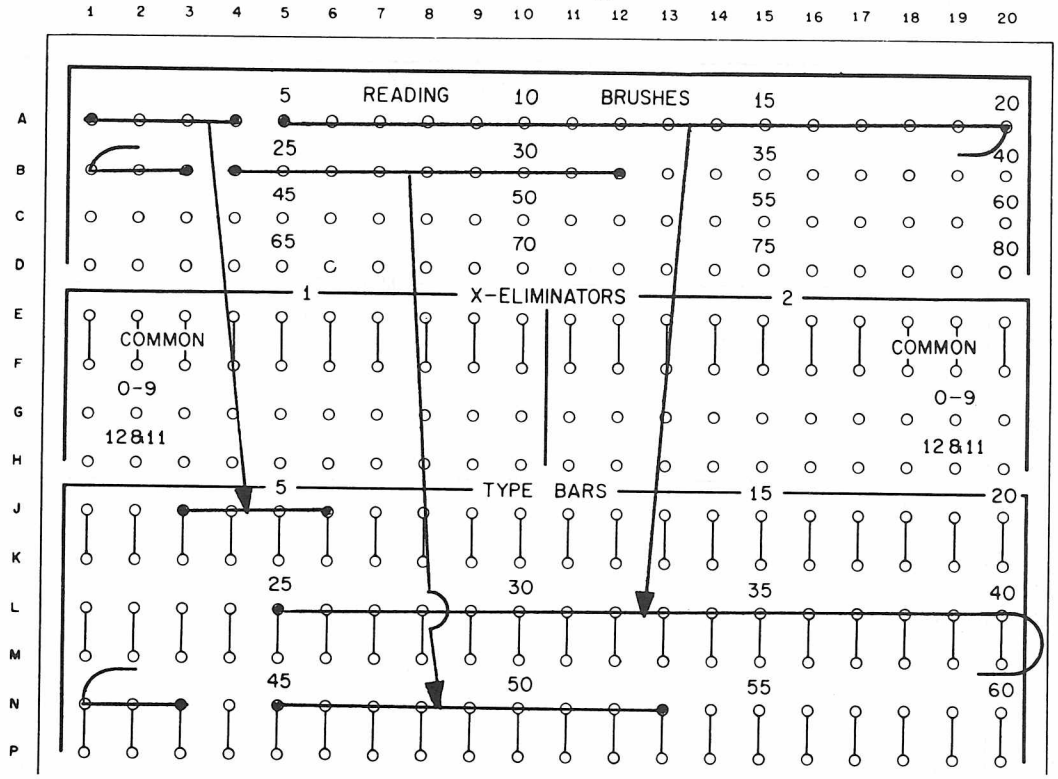


Figure 22.

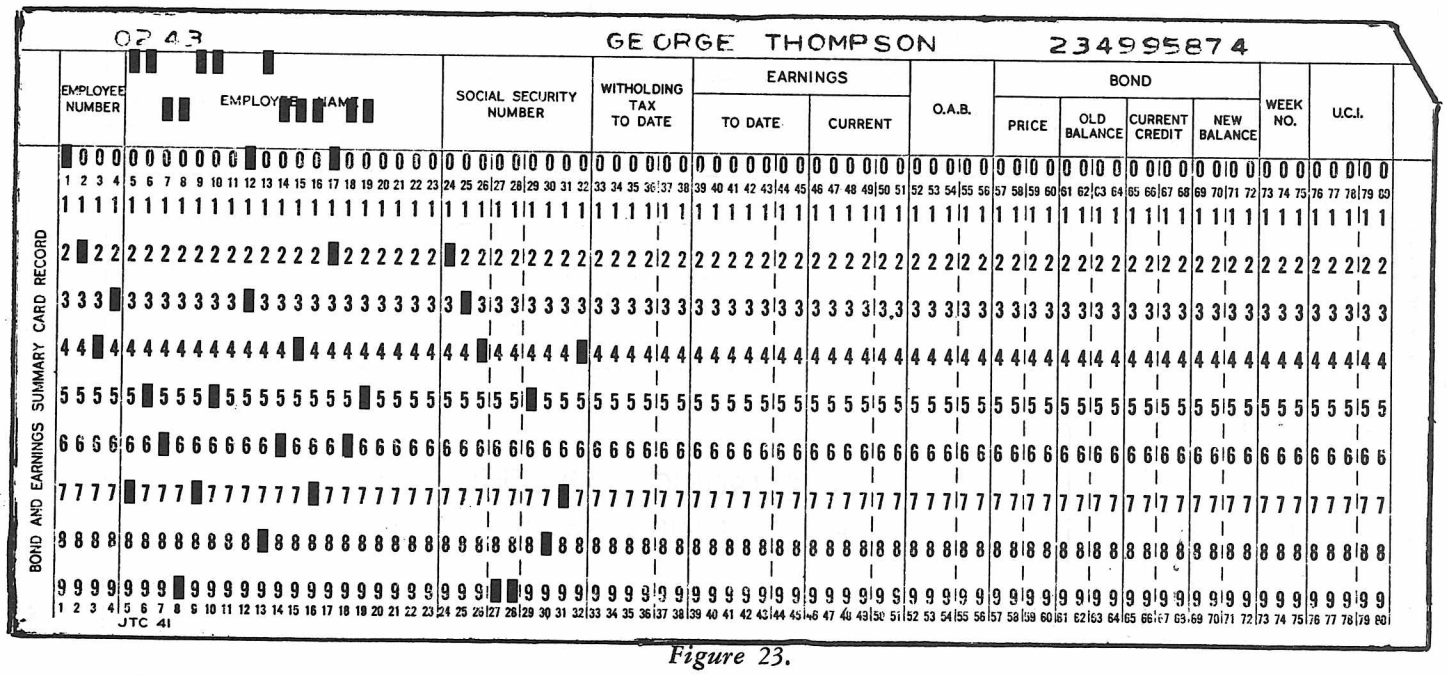
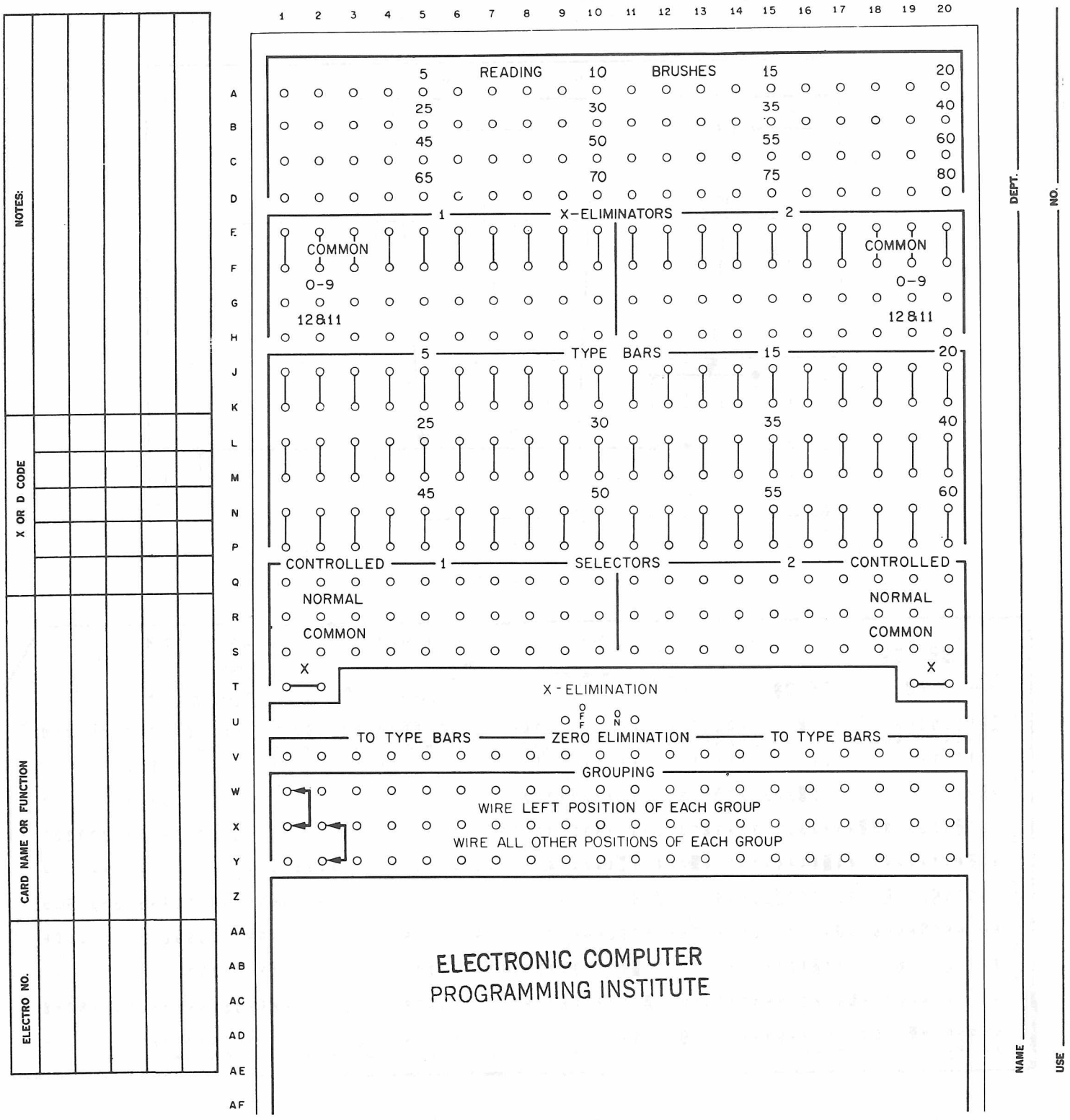


Figure 23.

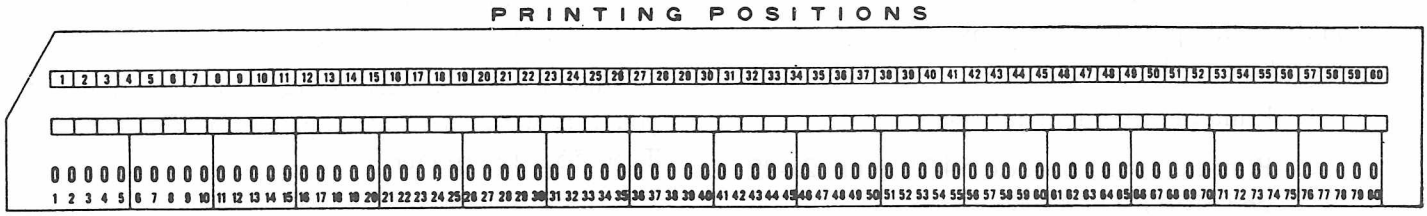
Exercises—Diagram the following three exercises on the blanks provided and compare your diagrams with those at the back of this lesson.

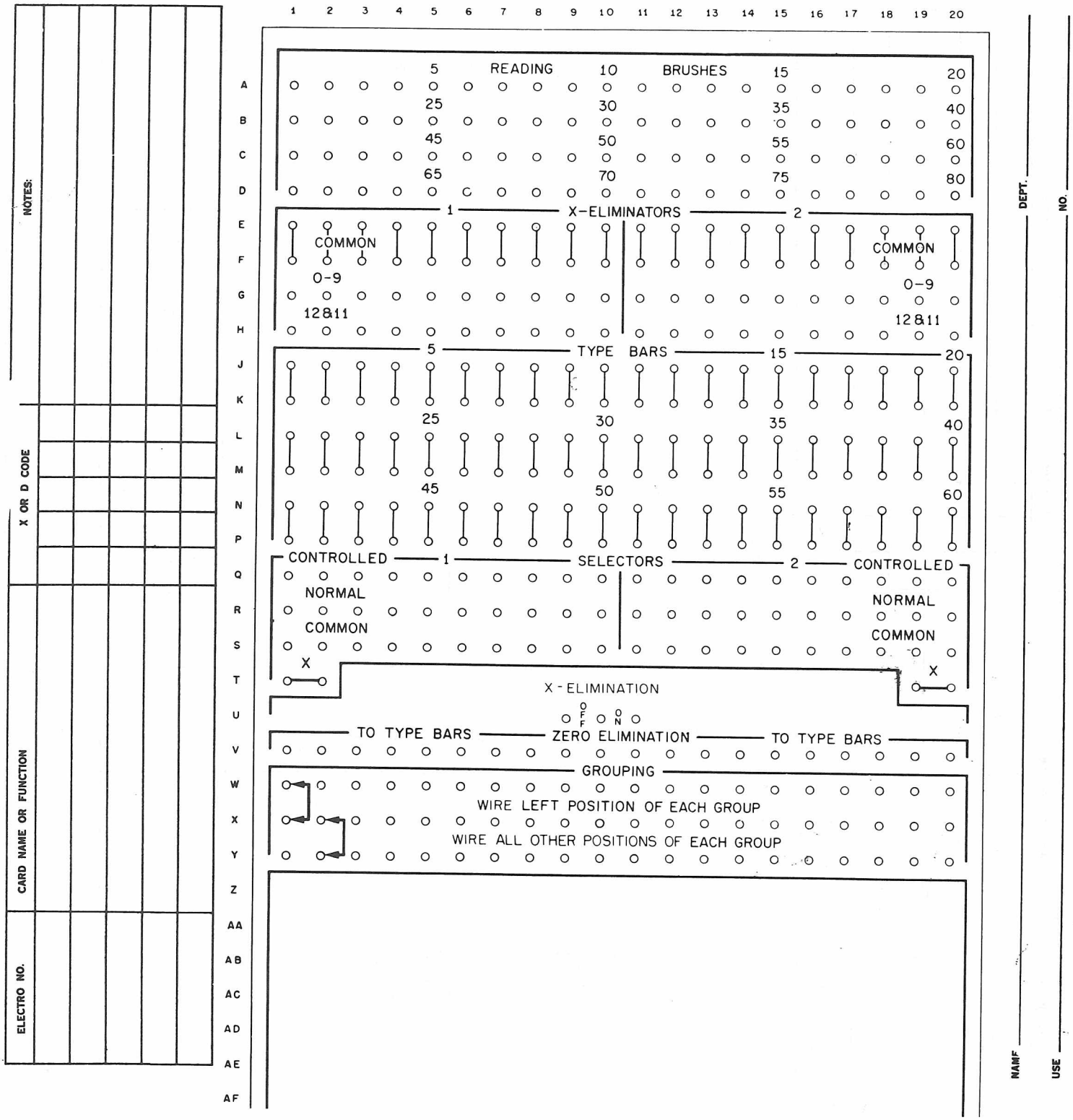
1. Print c.c. 39-44 in t.b. 8-13
2. Print c.c. 10 in t.b. 4; c.c. 54-58 in t.b. 21-25 and also in t.b. 43-47
3. Print c.c. 75-80 in t.b. 5-10; c.c. 9-14 in t.b. 13-18; c.c. 38-42 in t.b. 28-32

Study these diagrams. If you understand them, you can wire the control panel for the I.B.M. Type 552 Interpreter.

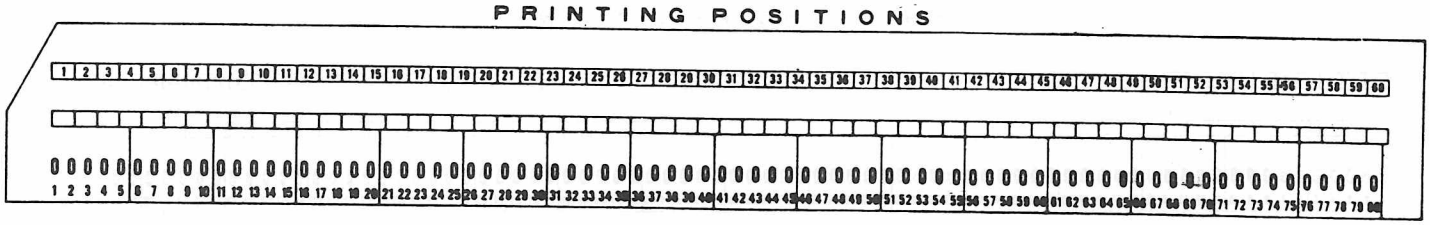


PRINTING POSITIONS





PRINTING POSITIONS

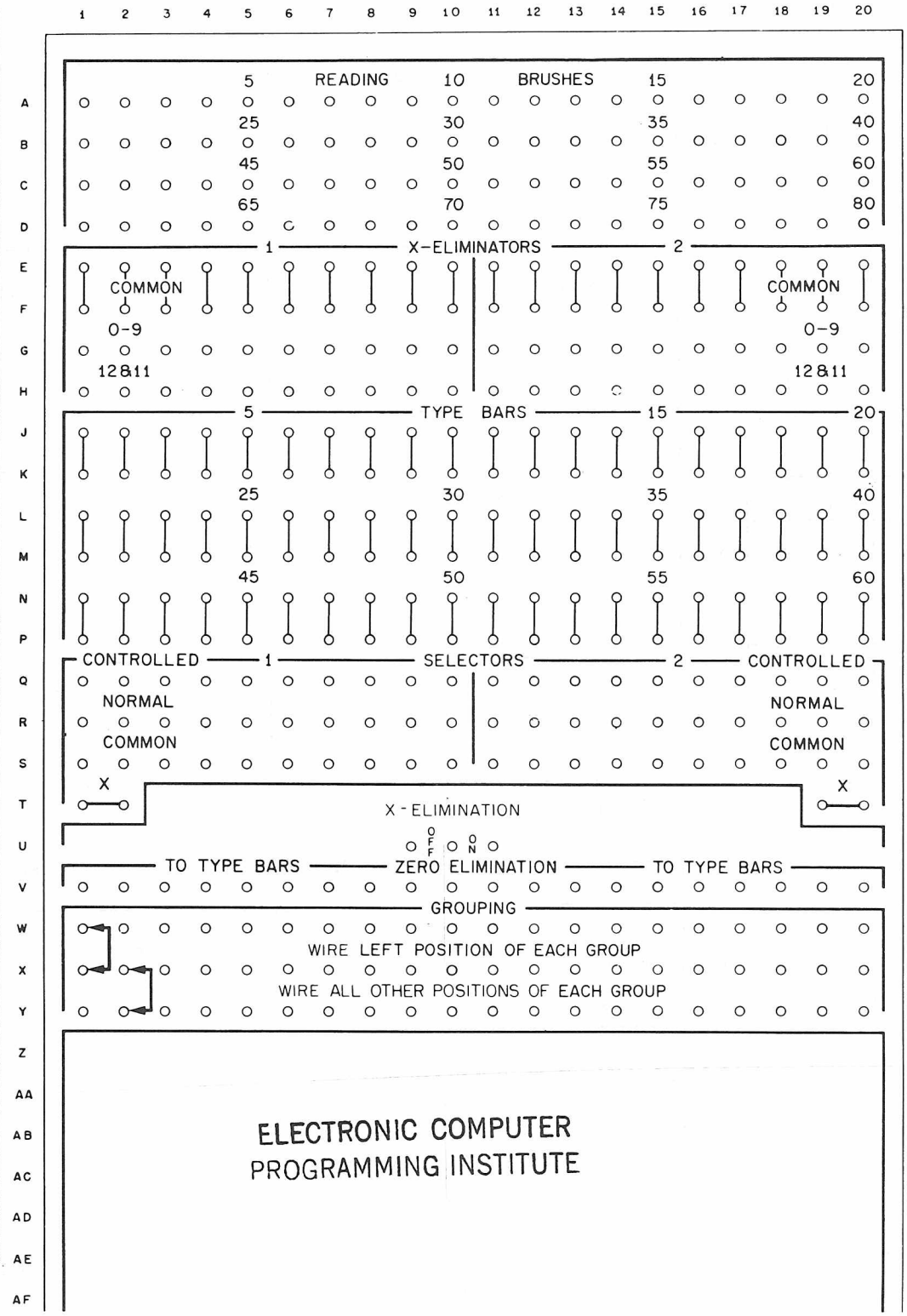


NOTES:

X OR D CODE

CARD NAME OR FUNCTION

ELECTRO NO.



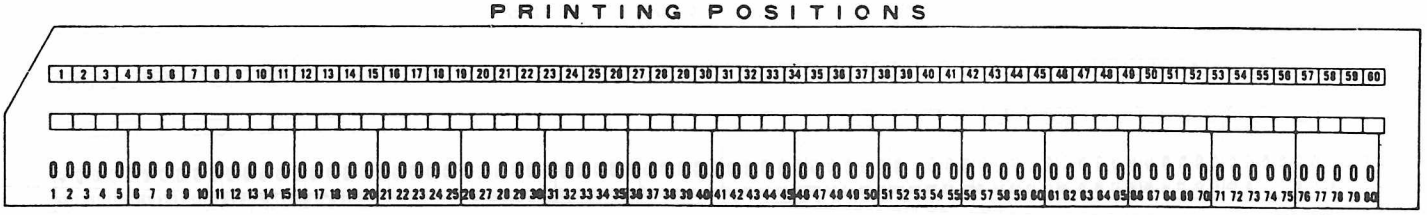
DEPT.

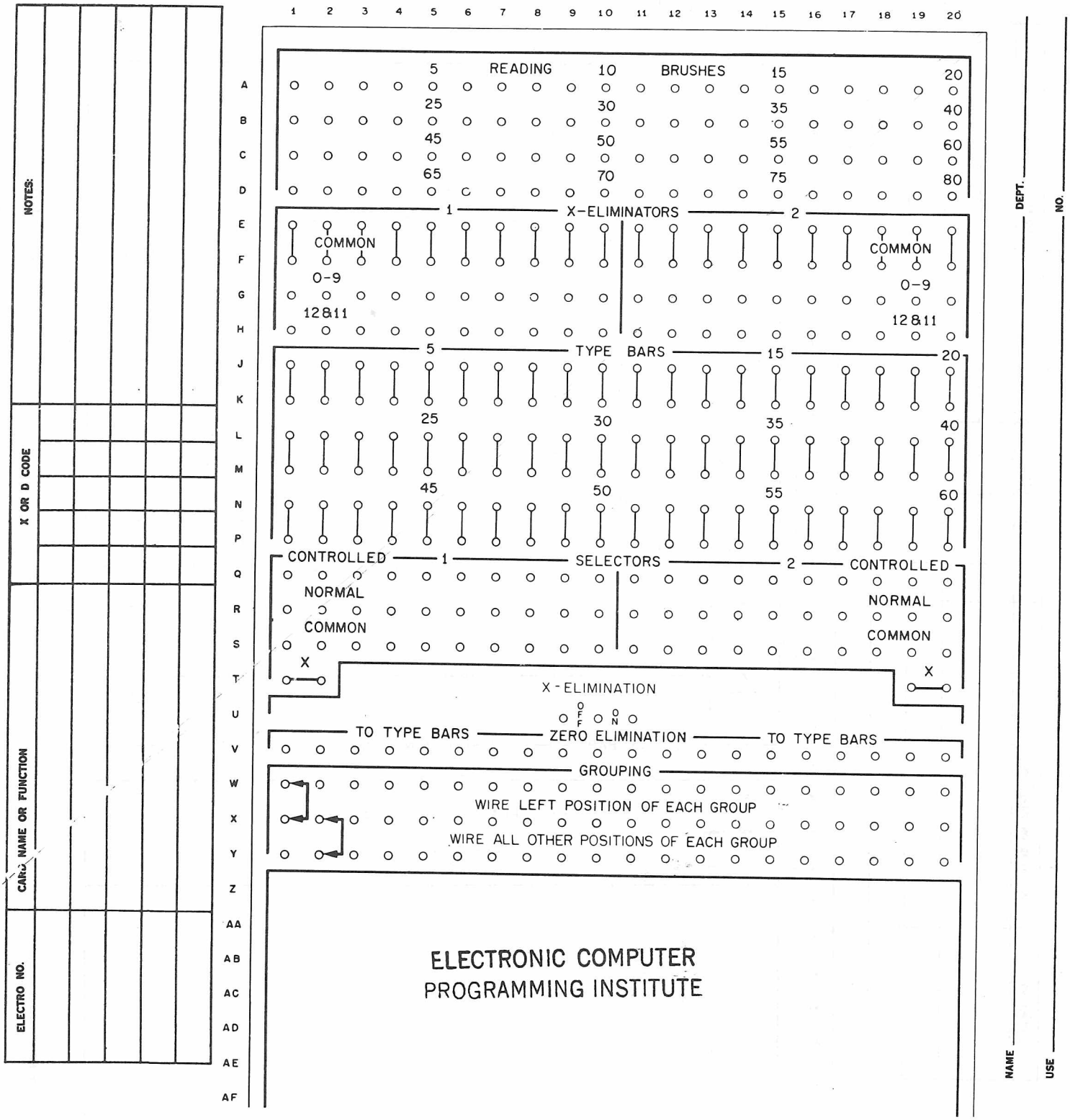
NO.

NAME

USE

PRINTING POSITIONS





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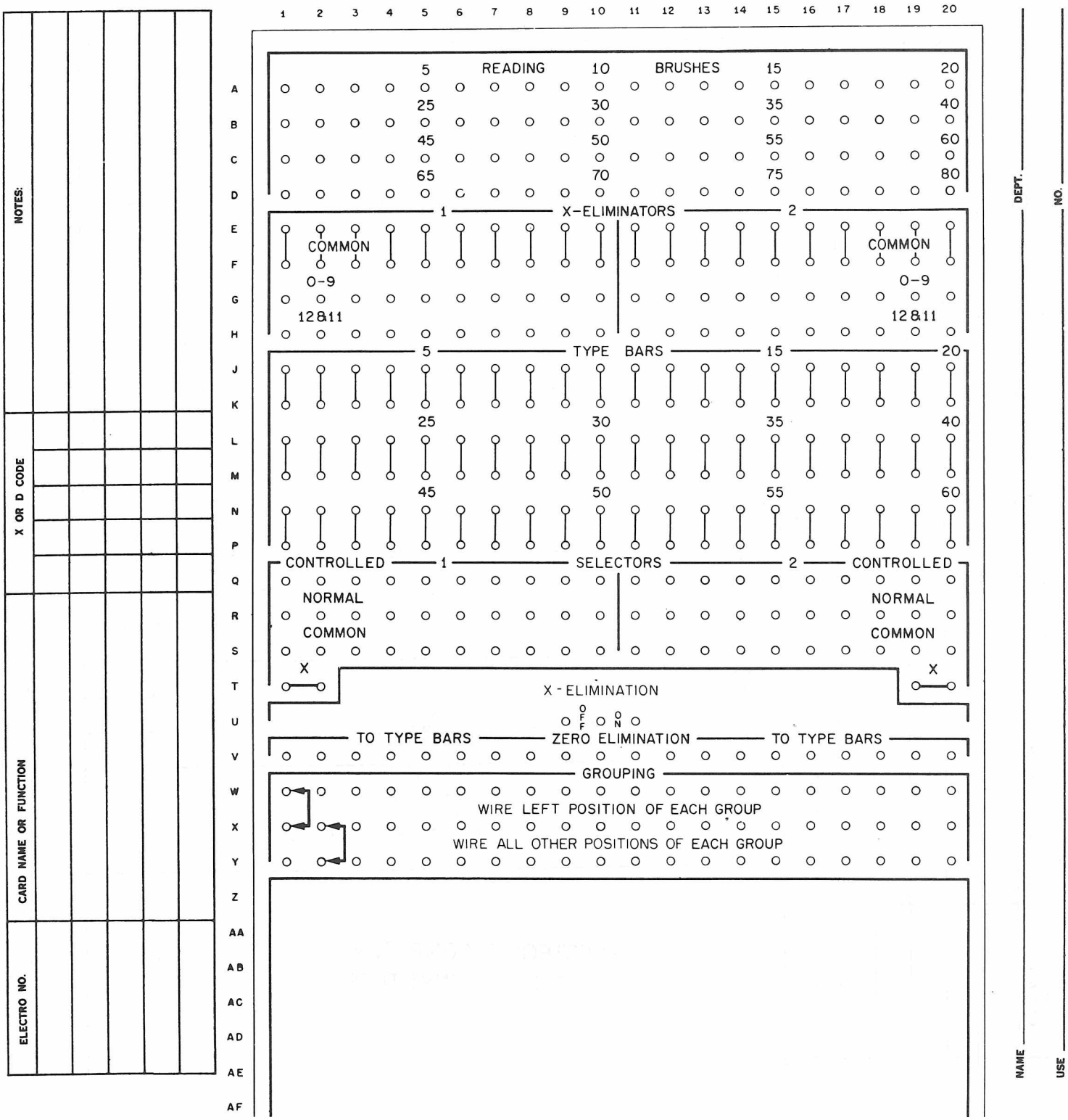

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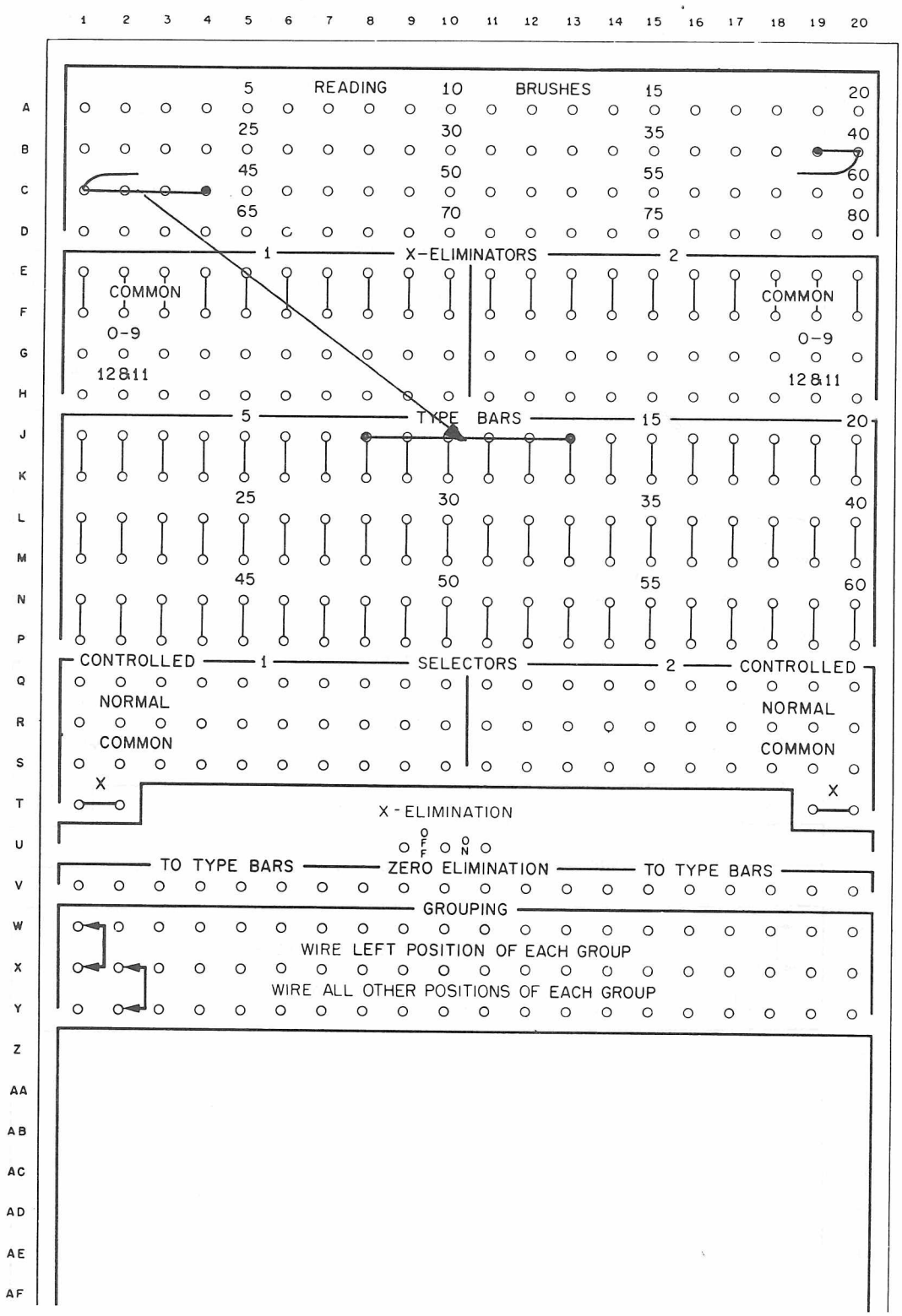
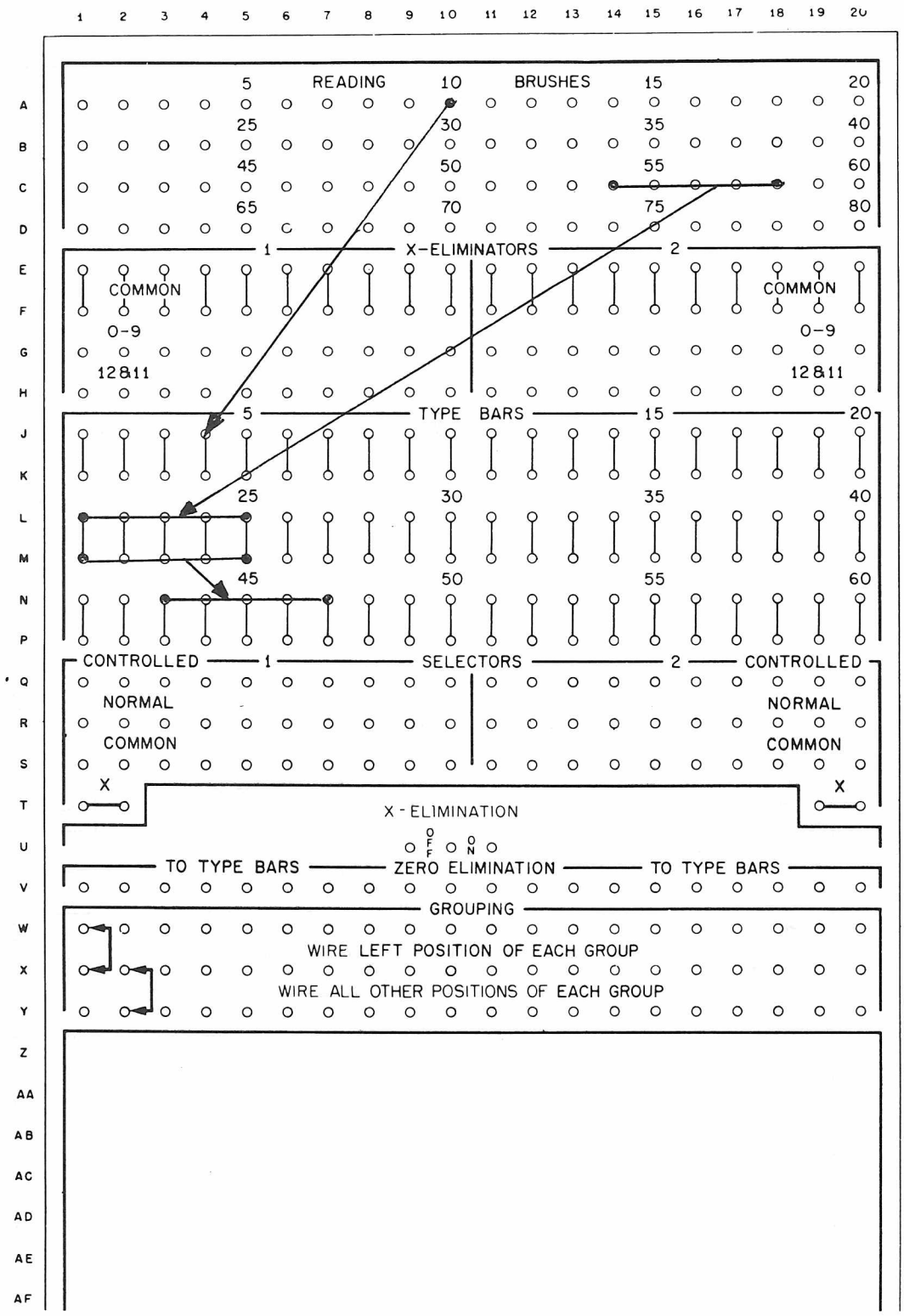
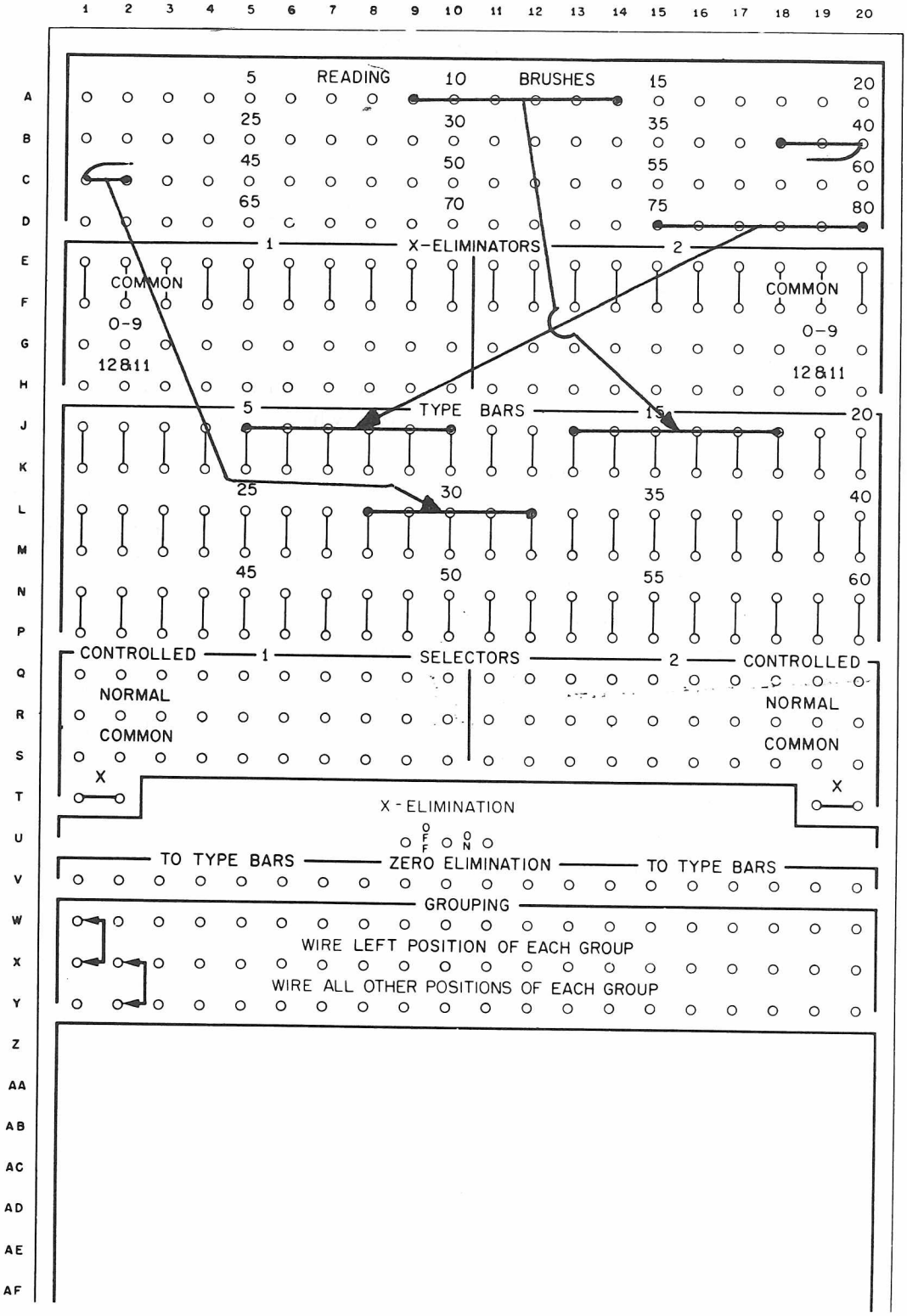


Solution to Exercise 1



Solution to Exercise 2



Solution to Exercise 3

GLOSSARY

Common Hubs—Two hubs linked together which perform the same function.

Control Panel—The device used to control I.B.M. machines. A metal frame which contains holes (called hubs). This frame fits into the machine. External wiring connecting these hubs controls the operation of the machine.

Cycle—The time it takes for a machine to complete a function.

Diagram—A paper copy of the control panel.

Entry—A hub on the panel which receives an impulse.

Exit—A hub on the panel which emits an impulse.

Hopper—That part of the machine which holds cards before they are processed. Feeding of cards takes place from the hopper.

Hub—A hole on the control panel.

Lower Line Printing—The printing line which is positioned between the 11 and 12 punching positions on the card.

Print Position Knob—Located on the back of the Interpreter. Used to control printing on the Upper of Lower line.

Reading Brushes—A wire brush used to sense punches in the card. There are 80 brushes in the Interpreter, one for each card column. Impulses sensed by these brushes are directed to the face of the control panel and can be found at the 80 exit hubs called "Reading Brushes".

Stacker—That part of the machine which receives and holds the cards after they have been processed.

Time—A particular portion of the basic machine cycle which identifies the position of the card being read.

Type Bars—There are 60 type bars in the Interpreter, one for each print position. This is the actual printing mechanism. They are activated by impulses sensed by the Reading Brushes and directed by control panel wiring to selected Type Bar Entry Hubs.

Upper Line Printing—The printing line which is positioned between the 12 punch position and the upper edge of the card.

EXAMINATION

INSTRUCTIONS — Be sure to study this lesson thoroughly before taking this examination. Read the question carefully, select the correct answer and mark the proper box on the answer sheet. Be sure to answer all questions. Review your answers before submitting them for correction.

1. The I.B.M. Interpreter is used to:
   a) Punch holes in cards.
   b) Correct cards which are damaged.
   c) Print information on the face of the card.
   d) All the above are correct.

2. The I.B.M. Interpreter can print information:
   a) Anywhere on the card.
   b) On the back of the card.
   c) On one of two printing positions.
   d) On one printing position only.

3. Cards feed into the Interpreter:
   a) Face down, 12 edge in.
   b) Face up, 12 edge in.
   c) Face up, 9 edge in.
   d) Face down, 9 edge in.

4. The speed of the IBM Type 552 Interpreter:
   a) Is 100 cards per minute.
   b) Depends on the number of columns being interpreted.
   c) Is 60 cards a minute.
   d) Can be changed by a knob on the back of the machine.

5. The Control Panel
   a) Is used to direct an I.B.M. machine.
   b) Can be inserted and removed in the machine with ease.
   c) Is very much like a switchboard.
   d) a-c are all true.

6. The IBM 552 Interpreter
   a) Has 80 reading brushes.
   b) Has 60 reading brushes.
   c) Has 1 reading brush.
   d) Has 80 print positions.

7. Which of the following statements is false
   a) An I.B.M. machine recognizes characters by the "time" an impulse is sensed.
   b) There are 360 degrees in every machine cycle.
   c) The Interpreter can print in both the upper and lower print positions at the same time.
   d) Information in the card can be printed in more than one place on the card.

8. Which of the following statements is true
   a) The Stacker holds cards before they are processed.
   b) Entry hubs emit impulses.
   c) Exit hubs emit impulses.
   d) There are 80 typebars in the Interpreter.

Questions 9-20 are either True or False. If True, mark an X in Answer Box A on your answer sheet; if False mark an X in Answer Box B.

9. Any column in the card may be printed anywhere on either the upper or lower printing lines.
10. The I.B.M. 552 Interpreter can print both numerical and alphabetical information.
11. Reading Brush hubs on the control panel are considered Entry hubs.
12. The hubs corresponding to each Type Bar on the control panel are "common."
13. To print information on the Interpreter, you should wire from Reading Brushes to Type Bars.
14. Information contained in the IBM card can only be printed in a single place on the face of the card.
15. An impulse generated between 110-100 degrees would be recognized by the Interpreter as a "4".
16. If during a card cycle, two impulses were generated, one between 230-220 degrees and one between 70-60 degrees, the Interpreter would recognize the character in this card column as an alphabetic character.
17. In order to print all 80 columns of a card it would be necessary to print on both the upper and lower printing lines.
18. The arrow used in control panel diagramming goes from Entry hubs to Exit hubs.
19. The Interpreter is the only IBM machine which uses a control panel.
20. A "cycle" is described as the amount of time required for a machine to perform a given function.

THE I.B.M. 548 INTERPRETER

The 548 Interpreter is illustrated in Figure 1 of this supplement. The operating characteristics of this machine are identical with those of the 552 Interpreter. The machine operates at a speed of 60 cards per minute; cards are fed into the machine face up, with the top edge (12 zone) entering the machine first.

Control panel wiring techniques are similar to those used with the 552. A few illustrations will indicate this. For normal

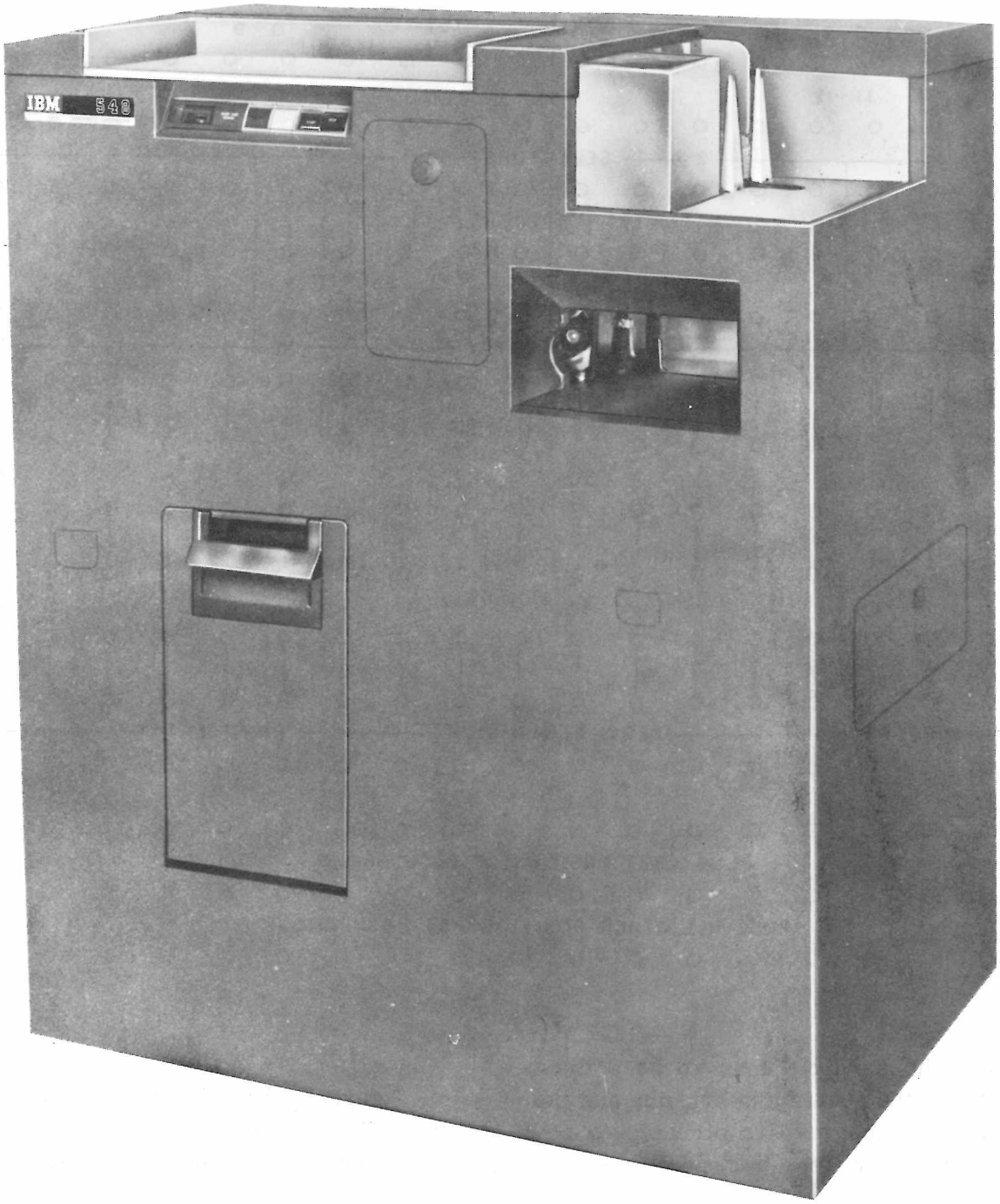


Figure 1

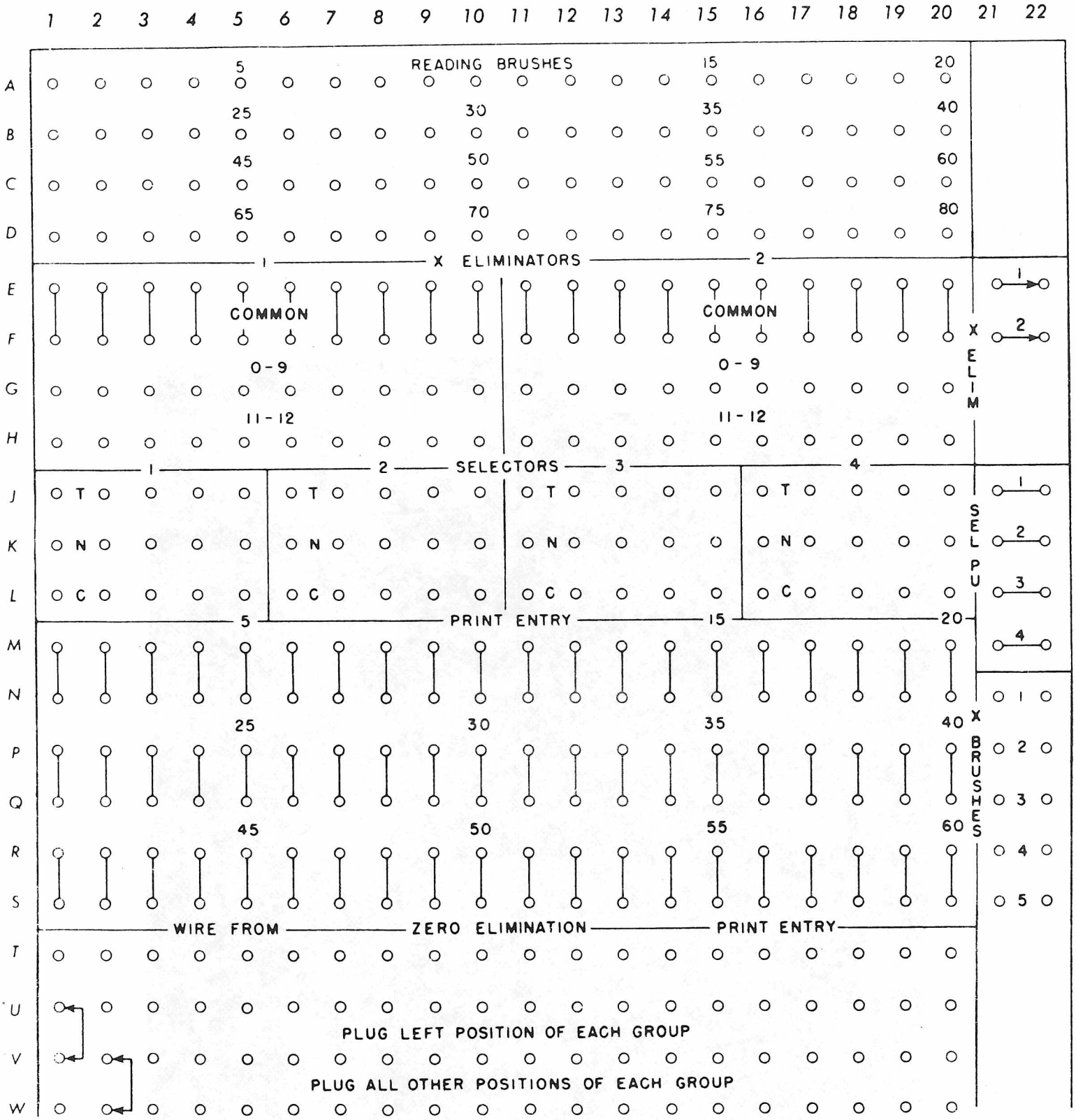


Figure 2

printing, the card columns to be printed are read by the 80 reading brushes and the information being read is directed to selected print entry (type-bar) positions.

Figure 3 illustrates the wiring for a typical problem. The facts pertaining to the problem are indicated below:

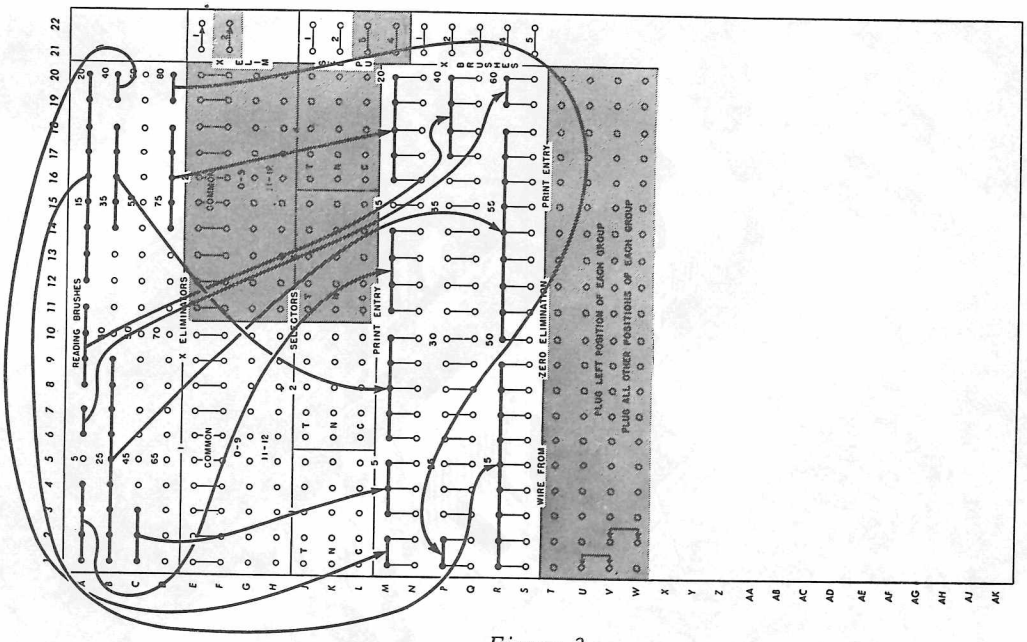


Figure 3

Problem: Wire the 548 Interpreter panel to accomplish the following:

Card Columns Typebars

Card Columns	Typebars
39-43	1-5
34-38	6-10
1-4	11-14
74-80	16-22
8-29	37-58
6-7	59-60

X-Elimination:

The first 10 X-Eliminators (E-H, 1-10) are standard on the 548; the other 10 X-Eliminators (E-H, 11-20) are optional. The wiring for X-elimination on the 548 is the same as the wiring on the 552 with one difference - the control panel switch for X-Elimination (E 21-22) must be plugged ON. Figure 4 illustrates a typical x-elimination Function. Card Column 6 is wired to X-eliminator 3; the numeric portion of the punch in c.c. 6 will print in typebar 4. If the machine had the second 10 X-eliminators, its switch (F 21-22) would be plugged. If the X-eliminator switch is not plugged, no impulse will reach the typebar and nothing will print.

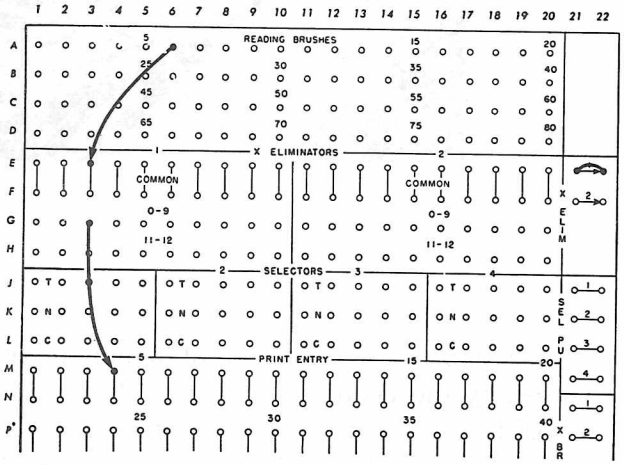


Figure 4

Selection:

The basic difference between the 552 and the 548 interpreter concerns the technique used to sense an X control punch in a card to control selection. In the 552, the card column which had the control punch would be wired directly to the selector X pick-up hub. If a particular card had an X-punch in the control column, the selector would be placed in a transferred position; if the card did not have the X-punch, the selector would remain in its normal position. In the case of the 552, the X-control punch would be sensed by the reading brushes (the same brushes that sense all the zones in the card.)

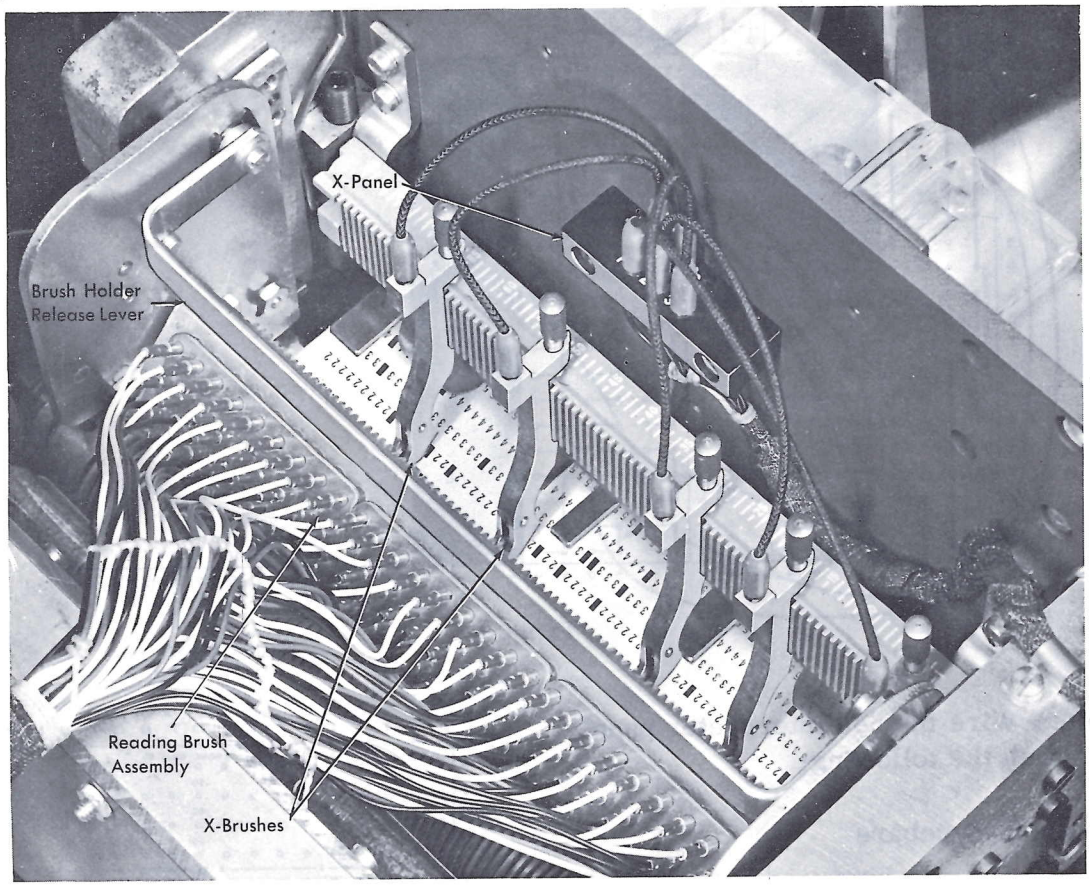


Figure 5

In the 548, the X-control punch is not sensed by the reading brushes. Instead, a set of five X-brushes (see Figure 5) is located in the machine just before the reading brushes. In other words, a card as it travels thru the 548 first passes under the 5 X-brushes, and then under the reading brushes.

Any of the X-brushes may be positioned by the operator to read any card column. If there is an X-punch in the card column being read by one of these brushes, an impulse will be available from the two common X-brush hubs on the control panel that correspond to that particular X-brush (1, 2, 3, 4, 5.) The X-brush hubs are located in N-S, 21-22.

The first 2 selectors are standard on the 548; selectors 3 & 4 are optional. Let us examine two problems which will illustrate selection on the 548.

Problem: We have a deck of cards which is to be interpreted. Some of these cards have an X-punch in cc. 33; others do not. If a card has an X-punch in cc 33, the information in cc 16-20 is to be printed in t. b. 56-60; cards without an X-punch in cc 33 the information in cc 16-20 is to be printed in t.b. 31-35. This is an example of class selection.

Figure 6 illustrates the control panel wiring required. In this instance, the operator of the machine will position X-brush 2 so that it reads cc. 33. These X-brushes are removable (a set screw holds them in place). This set screw is loosened, the operator removes the X-

brush, positions it over the designated card column (there is a calibrated guide in the machine), and then tightens the set screw.

Problem: Assume that we have a deck of cards which is to be interpreted. Those cards which have an X-punch in cc 60 are required to have cc 1-4 print in t.b. 37-40; cards without an X-punch in cc 60 are to have cc 11-14 print in t.b. 37-40. This is a field selection problem. Figure 7 illustrates the solution. In this instance, the operator has physically moved X-brush 1 so that it is positioned to read cc 60.

Figure 8 is a comparison of features of the two interpreters.

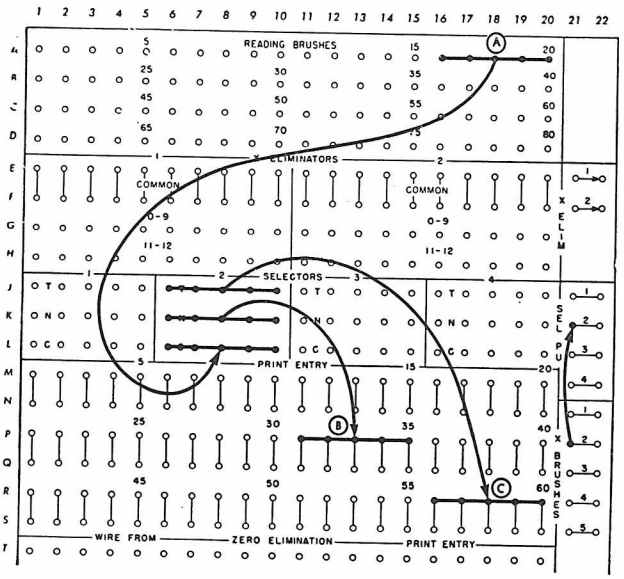


Figure 6

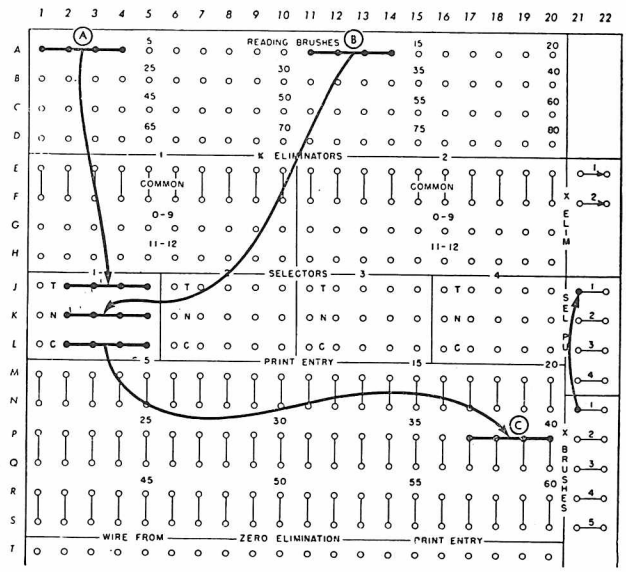


Figure 7

Features	*548*	*552*
Speed	60 cards per minute	Same
Capacity	Two 60-position lines	Same
Printing-Position knob	Located on back of machine. Turn right for upper, left for lower.	Same
Card feed	Face up, 12-edge first	Same
Control panel	22 hubs wide, 34 hubs long	20 hubs wide, 34 hubs long
Selectors	Two 5-position selectors standard	None standard
	Two 5-position selectors optional	Two 10-position selectors optional
	Picked up from X-brushes	Picked up from reading brushes
X-eliminators	10 standard, 10 optional	Same

Figure 8